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ALCOHOL-RELATED HARM AMONG YOUTH IN SWEDEN

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Thesis for Doctoral Degree (Ph.D.)

By

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To my family.

Popular science summary of the thesis

Compared to before the turn of the millennium, fewer young people now drink alcohol and fewer drink so much that they become intoxicated (binge drinking). This trend has been seen both in Sweden and in many other countries. Despite this development, the majority of young people in Sweden still drink alcohol. In 2022, approximately 40% of 15–16-year-olds and approximately 70% of 17–18-year-olds drank alcohol. Drinking alcohol is associated with negative consequences. For example, alcohol consumption remains the largest risk factor for mortality and morbidity among people aged 15–24 years.

Several studies have been done aimed at understanding why fewer and fewer young people drink alcohol, but the reason for the decline has not yet been established. Moreover, few studies have investigated how the decline in consumption has been reflected in alcohol-related problems among young people. The overall aim of the thesis is therefore to study alcohol-related problems among young people in Sweden. In the analyses, students' drinking habits, fathers' drinking habits and various measures of socioeconomic status (e.g. educational level) are related to alcohol-related problems among young people.

The results show that the students' academic orientation at upper secondary school is important for the number of the alcohol-related problems they experience. Students in vocational and introductory programmes experienced more alcohol-related problems than students in higher education preparatory programmes. Binge drinking is also strongly linked to alcohol-related problems. Binge drinking explains a large part of why students in vocational programmes experienced more problems than students in higher education preparatory programmes. Students in the introductory programme also experienced more alcohol-related problems compared to those in higher education preparatory programmes, but this was the case even if they had the same level of binge drinking.

The results also show that children whose fathers had received an alcohol-related diagnosis or been apprehended for public drunkenness ran a greater risk of receiving an alcohol- or drug-related diagnosis later in life, compared to children whose fathers had no such history. Despite the heightened risk among the former group, children whose fathers drank a large amount of alcohol but did not receive an alcohol-related diagnosis made up a larger proportion of all those who were given an alcohol- or drug-related diagnosis later in life.

The results suggest that broad efforts to decrease drinking among young people would likely reduce alcohol-related problems. The results also speak in favour of supplementing broad alcohol-prevention strategies with preventive efforts aimed

especially at students in the most vulnerable groups such as those on the introductory programmes, and children whose parents have problematic alcohol habits.

Populärvetenskaplig sammanfattning

Jämfört med före millennieskiftet är det idag färre ungdomar som dricker alkohol och färre som dricker så mycket att de blir berusade (berusningsdrickande). Detta är en utveckling som man har sett såväl i Sverige som i många andra länder. Trots den här utvecklingen dricker fortfarande majoriteten av unga i Sverige alkohol. År 2022 var det cirka 40 % av 15–16 åringarna och cirka 70 % av 17–18 åringarna som drack alkohol. Att dricka alkohol är förknippat med negativa konsekvenser. Till exempel är alkoholkonsumtion fortfarande den största riskfaktorn för dödlighet och sjuklighet bland personer i åldern 15–24 år.

I flera studier har man försökt förstå varför allt färre unga dricker alkohol, men orsaken till nedgången är ännu inte fastställd. Hur nedgången i konsumtion återspeglats i alkoholrelaterade problem bland ungdomar är det däremot få studier som har undersökt. Det övergripande syftet med avhandlingen är därför att studera alkoholrelaterade problem bland ungdomar i Sverige. I analyserna relateras elevernas dryckesvanor, pappornas dryckesvanor och olika mått på socioekonomisk status (tex utbildningsnivå) till alkoholrelaterade problem bland unga.

Resultaten visar att elevernas programinriktning på gymnasiet har betydelse för upplevda alkoholrelaterade problem. Elever på yrkesförberedande- och introduktionsprogram upplevde fler alkoholrelaterade problem än elever på högskoleförberedande program. Berusningsdrickande är också starkt kopplat till alkoholrelaterade problem. Betydelsen varierar dock mellan elever på de olika programmen. Berusningsdrickande förklarar en stor del av varför elever på yrkesförberedande program upplevde fler problem än eleverna på högskoleförberedande program. Eleverna på introduktionsprogrammet upplevde också mer alkoholrelaterade problem jämfört med de på högskoleförberedande program men detta gällde även om de hade samma nivå av berusningsdrickande.

Resultatet visar också att barn till pappor som fått en alkoholdiagnos eller blivit omhändertagna för berusning, löpte större risk att få en alkohol- eller narkotikarelaterade diagnos senare i livet, jämfört med barn till pappor som inte fått en diagnos eller blivit omhändertagna för berusning. Trots att risken var högre bland dessa barn utgjorde barn till pappor som drack en större mängd alkohol men inte fått en alkoholrelaterad diagnos, en större andel av alla dem som får en alkohol- eller narkotikarelaterad diagnos.

Resultaten belyser att minskat drickande bland ungdomar och bland deras pappor sannolikt skulle minska problem relaterat till alkoholkonsumtion bland ungdomar. Resultatet från avhandlingen pekar med andra ord mot att breda insatser för att minska drickandet bland unga troligen skulle leda till färre alkoholrelaterade problem. Men att

dessa med fördel även kan kompletteras med förebyggande insatser riktade särskilt till elever i de mest utsatta grupperna som de på introduktionsprogrammen, men även mot barn till föräldrar med problematiska alkoholvanorna.

Abstract

Background: Compared to before the turn of the millennium, adolescents are now less likely to drink alcohol and to engage in heavy episodic drinking, both in Sweden and in many other countries. However, in societies where alcohol is consumed, alcohol-related harm is almost always present and alcohol consumption is still the leading risk factor for mortality and morbidity among 15–24-year-olds and is related to a wide range of adverse consequences.

Overall aims: The overall aim of the thesis was to explore various previously understudied aspects of the epidemiology of alcohol-related harm (ARH) among young people. To this end, the four included studies focus on the associations of different exposures with the risk for ARH among young people. The exposures include: (i) individual levels and patterns of drinking; (ii) different indicators/measures of socioeconomic status (SES); and (iii) father's drinking habits. With the intent to explore the mechanism and pathways underlying the above associations, the studies also assess the possible importance of various confounding, mediating and moderating factors.

Data and method: Data for three out of four studies stemmed from a nationwide school survey conducted annually by the Swedish Council for Information on Alcohol and Other Drugs; it is a cross-sectional survey among students ages 15-18 with mainly self-reported data. The outcome self-reported ARH is consistent across the studies and has a skewed distribution prompting the use of negative binomial regressions. Since the respondents in the studies are clustered in school classes (study I, II and III) and in schools (study III) the assumption of independence between observations was violated, which was taken into consideration in each study.

One study was based on a prospective cohort with a study population of Swedish citizens 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. Cox regression models were used to estimate hazard ratios and 95% confidence intervals. Person-time was calculated from the time the individual turned 12 years of age until the first event of substance-related hospitalisation or mortality, reaching age 40 years, death or end of follow-up in 2009.

Results: In **study I** the overall aim was to examine how the trend in self-reported ARH among young Swedish alcohol consumers has followed the trend in their alcohol consumption during 1995–2012, and to test whether the strength of the association between individual level self-reported alcohol consumption and ARH is affected by the overall level of consumption among youth. The individual-level associations between the indicators of alcohol use and ARH were not significantly affected by changes in the

overall mean youth consumption. The trend in mean number of ARH shows a greater association to the variations in prevalence of heavy episodic drinking (HED) than to the trend in overall mean consumption.

In **study II** the overall aim was to examine how SES among youth is related to HED and ARH using three different indicators of SES. SES of destination (i.e., the students chosen academic orientation of study) was the most stable SES indicator for both outcomes; students in vocational programmes had higher odds of both HED and self-reported ARH compared to students in higher education preparatory programmes. The estimate for SES of the school environment also indicated more ARH in schools with lower-educated parents. After adjusting for volume of alcohol and HED, SES of the school environment still displayed a negative and significant estimate while the estimate for SES of destination became non-significant.

In **study III** the overall aim was to increase the understanding of the social gradient in ARH among youth, by studying a previously largely overlooked, but disadvantaged group of adolescents. The results indicated a negative social gradient, where the highest level of ARH was found among introductory students, followed by vocational students compared to higher education preparatory students. The associations were attenuated by about half after adjustments for risk factors, however there was still 43% more ARH among students in the introductory programme and 17% more among students in the vocational programme. While HED explained a large part of the excess risk among vocational students, it was a less important factor for introductory students.

In **study IV** the overall aim was to explore how fathers' alcohol use is related to the risk for substance-related disorders in their children, during youth and young adulthood. Each indicator of father's alcohol use was associated with a higher risk for substance-related disorders among children. Risk factors measured in childhood explained roughly between 40-70% of the associations. After adjustments, the highest risk was still found among children of fathers with the most problematic consumption, i.e. who had been apprehended for drunkenness or received an alcohol-related diagnosis. However, there was still a 63% higher risk of substance-related disorders among children whose fathers were in the highest alcohol consumption quintile in comparison to whose fathers did not drink alcohol.

Discussion and conclusion: All studied exposures were significantly associated with ARH. Both individual levels and patterns of drinking and indicators of fathers' alcohol use remained significantly associated with ARH after adjustment for other explanatory factors. Among the SES indicators, both SES of the school environment and SES of destination/academic orientation showed a negative association with ARH, also after adjustment for other risk factors.

List of scientific papers

I. Thor S, Raninen J, Landberg J. (2017) More Drinking, More Problems- Stable Association Between Alcohol Consumption and Harm Among Swedish Youth 1995-2012. Alcohol Alcohol. 2017 May 1;52(3):358-364.

II. Thor S, Karlsson P, Landberg J. (2019) Social Inequalities in Harmful Drinking and Alcohol-Related Problems Among Swedish Adolescents. Alcohol Alcohol. 2019 Jan 9;54(5):532-539.

III. Thor S, Landberg J, Karlsson P, Gripe I. Is there a social gradient in self-reported alcohol-related harm according to academic orientation? - A study among Swedish adolescents. Manuscript.

IV. Thor S, Hemmingsson T, Danielsson AK, Landberg J. (2022) Fathers' alcohol consumption and risk of substance-related disorders in offspring. Drug Alcohol Depend. 2022 Apr 1;233:109354.

Contents

List of abbreviations

AO	Academic orientation
ARH	Alcohol-related harm
CAN	The Swedish Council for Information on Alcohol and Other Drugs
HED	Heavy episodic drinking/binge drinking
HEP	Higher education preparatory programme
HR	Hazard ratios
ICD	International Classification of Disease
IP	Introductory programme
IRR	Incidence rate ratios
NCD	National Cause of Death Register
NHD	National Hospital Discharge Register
OR	Odds ratios
RR	Rate ratios
RERI	Relative excess risk due to interaction
SCB	Statistics Sweden
SES	Socioeconomic status
SDH	Social determinants of health
SRD	Substance-related disorders
VP	Vocational programme
WHO	World Health Organization

1 Introduction

In societies where alcohol is consumed, alcohol-related harm (ARH) is almost always present (Rehm et al., 2009). In addition, young people seem to be disproportionally affected by the adverse consequences of alcohol consumption. According to the World Health Organization (WHO) almost one in four deaths among young people (15-29-year-olds) were attributable to alcohol, to be compared with 5.5% in the whole population (WHO, 2018). It has also been revealed that the largest share of the alcohol-attributable burden of disease was among young people: 33.6% (Rehm et al., 2009). Thus, from a public health perspective, the use of alcohol among youth is of great concern and efforts to increase knowledge about ARH among young people are vital. Indeed, a stated objective in Swedish alcohol policy is that protecting children and young people from their own and others' harmful use of alcohol is an important part of public health policies and should continue to form the basis of the health-promoting and preventive work (Socialdepartementet, 2022).

Adolescence is a sensitive period of the life course with great importance for later health (Viner et al., 2015). Moreover, since alcohol use and other risk behaviours typically are initiated during this period, an important question is to what degree these factors translate into risk of ARH later in life (Hall et al., 2016; Merline et al., 2008). Another key aspect of ARH is the large social gradient usually observed in the general population for this outcome. In view of previous research indicating that the most disadvantaged groups tend to suffer a disproportionate number of problems from their drinking (Hemström, 2002; Makela and Paljarvi, 2008), it is also important to increase our knowledge of how ARH is distributed among young people, as well as what factors may contribute to why some groups experience more ARH than others.

Sweden is traditionally known as a country where a majority of the population drinks alcohol, with a corresponding high proportion of young people drinking alcohol. However, at the end of the 1990s a gradual drop in the proportion of young consumers occurred and a few years into the 2020s, less than 40% among 15-16-year-olds and less than 70% among the older students, 17–18-year-olds, reported use of alcohol (Zetterqvist, 2022). As expected, both the self-reported volume of alcohol and the number of self-reported ARHs dropped during these years. Similar developments were visible among adolescents in most European countries as well as in USA and Australia (Kraus et al., 2016; Miech et al., 2017; Moore et al., 2016).

Several studies have analysed the decline in youth consumption with the main focus on why drinking has been declining among young people (Pape et al., 2018; Raninen et al., 2013; Raninen et al., 2022). Despite extensive research, the cause of the decline is yet to be established (Pape et al., 2018). Several studies have argued in favour of the theory of collectivity of drinking (Skog, 1985) proposing that the decline has occurred across

consumption levels (Norstrom and Svensson, 2014; Raninen et al., 2014). However, few studies have examined how the decline in consumption has been reflected in the burden of ARH among youth.

Against this background the overall aim of the thesis was to study aspects of the epidemiology of ARH among adolescents, and the four presented studies explore associations between different exposures and risk for ARH.

2 Background and conceptual framework

The following section gives a background to the field and conceptual framework of the epidemiology of ARH among young people. The chapter is divided into the themes most relevant for the thesis' main objectives. The thesis includes four studies and an overview is provided in figure 1.

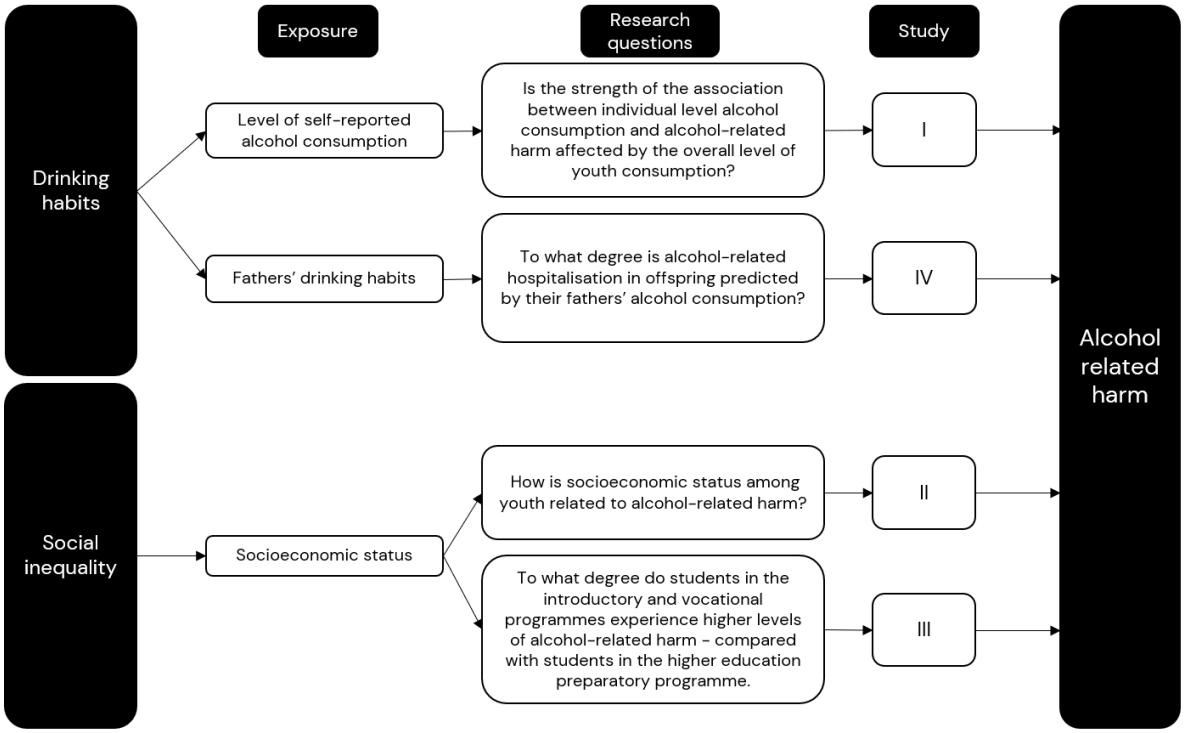


Figure 1. Overview of the themes and studies of the thesis.

2.1 Social determinants of health

Health is related to a wide range of factors, usually referred to as social determinants of health (SDH) (Marmot et al., 2008). They include factors that influence people's health outcomes and can be the conditions under which people are born, grow up, live, work and age (Marmot et al., 2008). Inequality in health refers to a systematic difference in health that could have been avoided given the right policy interventions (Loring, 2014). According to the SDH framework, health inequalities emerge when there is an unequal distribution of SDH. In research where the SDH framework is used, it is often distinguished between the upstream and downstream perspective. Downstream perspective focuses on individual behaviours and seeks to address health inequalities by targeting specific risk factors, such as alcohol use, while upstream perspective focuses on social and environmental factors that shape health outcomes (WHO, 2010).

Adolescents grow up in a multi-layered network of relationships, encompassing family, peers and community, that can have a profound impact on their present and future health (Viner et al., 2012). Socioeconomic status, family factors, school environment, educational achievements and health-related behaviours are some of the factors, or SDH, that might affect the risk of negative outcomes in life, including ARH (Kuh et al., 2003).

2.2 Alcohol-related harm among adolescents

2.2.1 Alcohol-related harm

ARH is often subcategorised as health-related and social-related harm (Hall et al., 2016; Rehm et al., 2009) and thereafter divided into acute and long term. Acute health-related harm includes e.g. unintentional injuries, traffic accidents and poisonings, while long term health-related harm includes cancer, cirrhosis of the liver and alcohol use disorders (Measham and Ostergaard, 2011) among other things. Acute social-related harm on the other hand includes acute harm to others such as driving under the influence and violence (Boden and Fergusson, 2011; Hall et al., 2016; Measham and Ostergaard, 2011). Long term social consequences related to alcohol impose a burden on the individual and society through low educational attainment, reduced employment in adulthood, adverse drinking patterns in adulthood and adverse effects on offspring in early adulthood (Hall et al., 2016; Odgers et al., 2008).

Information on severe forms of negative health consequences of alcohol is commonly gathered by using register data on alcohol-related morbidity or mortality. In Sweden such register data come from for example the National Cause of Death (NCD) Register and the National Hospital Discharge (NHD) Register where alcohol-related diagnoses and causes of deaths are assigned ICD codes (International Classification of Disease). However, a large proportion of all ARH does not end up in registers, especially among young people who engage in drinking away from adult supervision. To estimate the prevalence of these types of harm, one has to rely on self-reported information. Both in the Swedish national survey among students in year 9 and 11 and in the European school survey among 15-16-year-old students, questions are included in order to reach a better understanding of the risky behaviours and harm adolescents are exposed to in association with alcohol use (Kraus et al., 2016; Zetterqvist, 2022). These include the presence of violence and accidents in association with alcohol consumption, victimisation, driving under the influence and disturbances in close relationships. Although relatively insignificant forms of harm such as lost or damaged belongings and problems with friends and family are the ones most commonly reported, more than one out of ten in the 2022 Swedish national survey reported driving under the influence or sustaining injuries in association with alcohol consumption (Zetterqvist, 2022).

The term harm is widely used in research on alcohol-related problems or consequences (Babor, 2023) even though one might argue that e.g. driving under the influence or loss of valuables in the strict definition is not harm. However, henceforth in this thesis, the terms alcohol-related harm (ARH) and problems will be used interchangeably for the entire spectrum of alcohol-related problems.

2.2.2 Alcohol-related harm and the adolescent experience

Adolescence is a phase of life, and no stage of life can be considered in isolation from the others; on the contrary, one's health is largely shaped by exposures earlier in life (Jones et al., 2019). Adolescence is also a time of neurological, cognitive and social maturation, making adolescents extra vulnerable to alcohol (Brown et al., 2008; WHO, 2014). Since social and cognitive skills are not fully developed, young people are to a larger extent risk takers and their decisions are not always well thought out. This increases the risk of harm associated to alcohol use and intoxication, in comparison to adults. Using substances during such a sensitive period in life is not only associated with acute harm but can disrupt the important social transitions from adolescence to adulthood, impact a young person's life trajectories and influence health-related behaviours later in life (Hall et al., 2016).

Consequently, it is of importance to gain a greater knowledge about adverse exposures in regard to ARH among adolescents because there is an increased risk of both acute and long-term harm.

2.3 Drinking habits and alcohol-related harm

At the national level, alcohol consumption is usually measured as alcohol per capita (APC) which is normally calculated by combining recorded sales and unrecorded consumption (Bruun et al., 1975). However, to get an idea of how many in a population drink alcohol, one has to rely on population surveys with self-reported data. Instruments adapted to measure drinking patterns can be used to estimate both total alcohol consumption and drinking patterns such as HED and drinking frequency.

2.3.1 Youth drinking and alcohol-related harm

To understand through which mechanisms alcohol use is related to harm, more than one dimension of use needs to be considered (Babor, 2023). Several studies have demonstrated a strong relationship between HED/binge drinking and ARH (Rossow et al., 2013; Svensson and Landberg, 2013; Wells et al., 2007). HED is a key mechanism through which alcohol consumption causes related harm. A study by Kraus et al. (2009) demonstrated how occurrence of HED was a better predictor of alcohol-related social harm than volume of consumption. On the individual level HED impairs, among other things, one's judgement, reaction time and psychomotor abilities, all of which increase the risk of ARH such as accidents, dangerous risk-taking and harm to others (Babor,

2023). The association between drinking pattern and ARH is also well established among young people (Andersson and Hibell, 2007; Bye and Rossow, 2010; Danielsson et al., 2012). Considering that adolescents in addition tend to drink larger quantities of alcohol per occasion compared with adults (Chung et al., 2018) this emphasises the importance of not only exploring the relationship between volume consumed and harm, but also including the pattern of drinking in such analyses among adolescents.

Another factor to take into consideration is the possible contextual effect of overall volume of consumption in the youth population. Indeed, findings from Nordic survey data suggest that the strength of the relationship between alcohol consumption and related harm at the individual level may be moderated by the overall level of consumption in the youth population. Suggesting that the relationship between consumption and harm is stronger in periods when mean alcohol consumption is low and weaker in periods when the mean alcohol consumption is high (Bye and Rossow, 2010; Landberg and Hubner, 2014).

By exploring how the relationship between alcohol use and ARH is moderated by overall volume of consumption, previous studies have in a way investigated if a normalisation or a denormalisation of alcohol use has occurred. The substance use normalisation thesis was proposed by Parker et al. (2002) and if one were to apply the normalisation process to our conditions, it would suggest that alcohol consumption would be viewed as a normalised behaviour during periods when the overall youth consumption is high. The adolescents participating in drinking would then be part of a group with a large proportion of well-adjusted individuals. Therefore, the associations with behaviours and traits that may increase the risk of ARH, such as impulsivity, risk-taking and delinquency, would not be as strong as during periods of low consumption among youth. During such periods, alcohol use would be denormalised and would be deemed a more deviant behaviour. Adolescents participating in drinking would consequently constitute a much smaller group and would to a greater extent include individuals with norm-violating or problem-prone behaviour, which is theoretically related to a greater risk of experiencing ARH.

The discussion of a possible denormalisation process in youth drinking is ongoing (Caluzzi et al., 2022; Rossow, 2022). Some studies exploring the relationship between high alcohol intake or intoxication and problem behaviour have found evidence for a change in the relationship (Sznitman et al., 2013). Pape et al. (2008) found that the relationship between intoxication and delinquency became weaker when intoxication became more prevalent.

To sum up, it is important to consider different dimensions of alcohol consumption when studying the mechanism(s) underlying ARH. And although several studies have demonstrated a collective shift in line with the theory of collectivity, among adolescents,

the question remains whether the burden of ARH has declined in parallel with the declining consumption.

2.3.2 Parental drinking habits and alcohol-related harm among the children

Parental problematic drinking habits have in many studies been associated with adverse consequences among the children and can thus constitute a risk factor for children to develop negative health behaviours. In two recent Swedish studies problematic parental drinking habits were associated with an elevated risk that the children would have poor health and low school performance (Ramstedt et al., 2023) and higher levels of psychological and somatic problems (Wahlström et al., 2023). Moreover, several studies have demonstrated that alcohol-related disorders among parents can be linked to harm (both social and health-related) among the children, including substance misuse as well as behavioural problems and poorer general health (Dube et al., 2002; Johnson and Leff, 1999).

Furthermore, prenatal alcohol exposure and children of parents with clinically diagnosed alcohol disorder have been the focus of many studies (Rossow et al., 2016). When discussing family transmission of substance abuse, genetic transmission and transmission of psychobiologic markers of vulnerability are of course of interest. Children of parents with clinically diagnosed alcohol disorder are considered to have a greater risk of developing alcoholism due to a combination of risk factors, both social and genetic (Johnson and Leff, 1999; Rossow et al., 2016).

However, in a review by Rossow et al. (2016a) the authors highlighted that fewer studies have assessed the risk of ARH among children whose parents lack clinically diagnosed alcohol problems but have problematic drinking behaviour (hereafter called subclinical drinking). The few studies performed are based on the children's perception of parental drinking and have demonstrated a positive association between drinking frequency among fathers and alcohol-related hospitalisation (Hemmingsson et al., 2017) and mortality (Landberg et al., 2018) among their children.

Whereas findings from research suggest that parental sub-clinical drinking tends to be linked with alcohol-related adverse consequences among the children, less is known about whether the associations are confounded by unmeasured factors (Rossow et al., 2016). In a review by Johnson and Leff (1999), families in which one or both parents have substance use disorder often suffer from several negative contexts with the potential of disrupting family life. Problematic parental alcohol consumption might for example negatively impact a parent's ability to maintain their parental responsibilities (Guttmannova et al., 2017; Johnson and Leff, 1999). Further, studies have indicated that a low quality parent–child relationship or low quality parental support, is associated with alcohol misuse among the children (Yap et al., 2017). This kind of dysfunctional family

environment increases the risk for disruption of the adolescent's transition into adulthood and for family transmission of alcohol abuse (Johnson and Leff, 1999).

This accumulation of alcohol-specific and alcohol-related factors often prevents inference of causal links between parental drinking and adverse outcome in the children (Rossow et al., 2016). An example is found in a cohort study (Berg et al., 2016) where the link between parental alcohol-related diagnosis and worse school performance in offspring was in large part attributable to factors in addition to diagnosed alcohol disorders, e.g. parental mental health, drug use, criminality and welfare interventions.

Finally, most studies focusing on the effects of parental sub-clinical drinking have used adolescent drinking behaviour among the children as outcome (Adalbjarnardottir and Rafnsson, 2001; Duncan et al., 2011); there seems to be a lack of studies investigating more long-term and severe consequences, e.g., alcohol-related hospitalisation and mortality. Moreover, while this group of children whose parents drink on a sub-clinical level may be expected to have a lower risk of harm than children of parents with diagnosed alcohol disorders, they will most likely account for a considerable proportion of all harm in this context, given the fact that they are more numerous.

2.4 Social inequality in alcohol-related harm

There is considerable evidence of a social gradient in ARH in the general population, with higher rates of alcohol-related morbidity and mortality in groups with low SES (Cavelaars et al., 1997; Mackenbach et al., 2003; Mackenbach et al., 2015; Makela and Paljarvi, 2008). For example, a Swedish study demonstrated that the risk of alcohol-related disorders was four times higher among manual compared to non-manual workers (Syden et al., 2017). This pattern is demonstrated regardless of which indicator is used to measure SES, i.e. education, occupational class (Mackenbach et al., 2015; Makela and Paljarvi, 2008) or income (Hanson and Chen, 2007b).

Studies of potential effects of SES and alcohol use on children have revealed a less consistent pattern, where the strength and direction of the relationship have varied across studies (Hanson and Chen, 2007a, b). While some studies demonstrate an elevated risk of harmful drinking among adolescents whose parents have low SES (Droomers et al., 2003; Pape et al., 2016) others find evidence that alcohol use is more common among children whose parents have high SES (Hanson and Chen, 2007b).

Still, some studies in recent years have revealed a pattern in the association between SES and alcohol use and ARH among young people. A study from the United Kingdom, demonstrated how high SES among the parents predicted elevated alcohol consumption and HED among the children, whilst low SES was associated with ARH (Kendler et al., 2014). The same pattern was observed among Danish students, where high parental education was associated with HED but low parental education was

associated with higher odds of ARH among drinkers (Møller et al., 2019). Moreover, a Norwegian study demonstrated that students from more affluent areas in the capital of Norway, had higher alcohol use and intoxication, while adolescents in less affluent areas reported more ARH (Pedersen et al., 2015).

Studying SES among young people is complicated by the fact that SES can be measured on different levels. While SES indicators among adults often relate to the individual (e.g. education, occupation or income), adolescents are balancing between their parents' SES and the acquisition of a societal position of their own. Thus, while SES among youth traditionally has been measured using indicators of parents' educational level or occupation (Hanson and Chen, 2007a), an alternative approach to studying social inequality among young people is based on the notion that adolescents have started spending more time in school and with friends and thus less time with their parents. In line with this approach, Hansen and Chen (2007) reason that an adolescent's social status among peers might exert a stronger influence than the family's social status. Researchers have therefore debated whether the school environment might represent a more relevant context for adolescent drinking habits. Hence, the SES of classmates would represent a more relevant measure than does the SES of parents (Olsson and Fritzell, 2015; West, 1997). Indeed, studies have demonstrated how health behaviours vary according to the socioeconomic composition of the school (Ennett et al., 1997; Olsson and Fritzell, 2015). A study on students in Stockholm demonstrated that the risk for high alcohol consumption increased in parallel with the school's SES (Olsson and Fritzell, 2015).

Another alternative approach – which may capture the experience of adolescents' placement within a social context and simultaneously take into account their transition to adulthood and path toward establishing their own SES – is to consider the academic orientation (AO) they have chosen at school as an indicator of SES (Hagquist, 2007). AO refers to the type of education the students attend in upper secondary school. Swedish schools offer three types: higher education preparatory programme (HEP), vocational programme (VP) and introductory programme (IP). This SES measure would then represent a proxy indicator of future SES. Some support for this approach is found in research demonstrating that young peoples' educational level and occupational status might be an important predictor of health inequalities (Bosque-Prous et al., 2017; Gauffin et al., 2015; Hagquist, 2007; Rahkonen et al., 1995). In a comparative study across several European cities, Bosque-Prous and coworkers found an association between adolescent alcohol use and adolescents' own SES, but not with the parents' SES (Bosque-Prous et al., 2017).

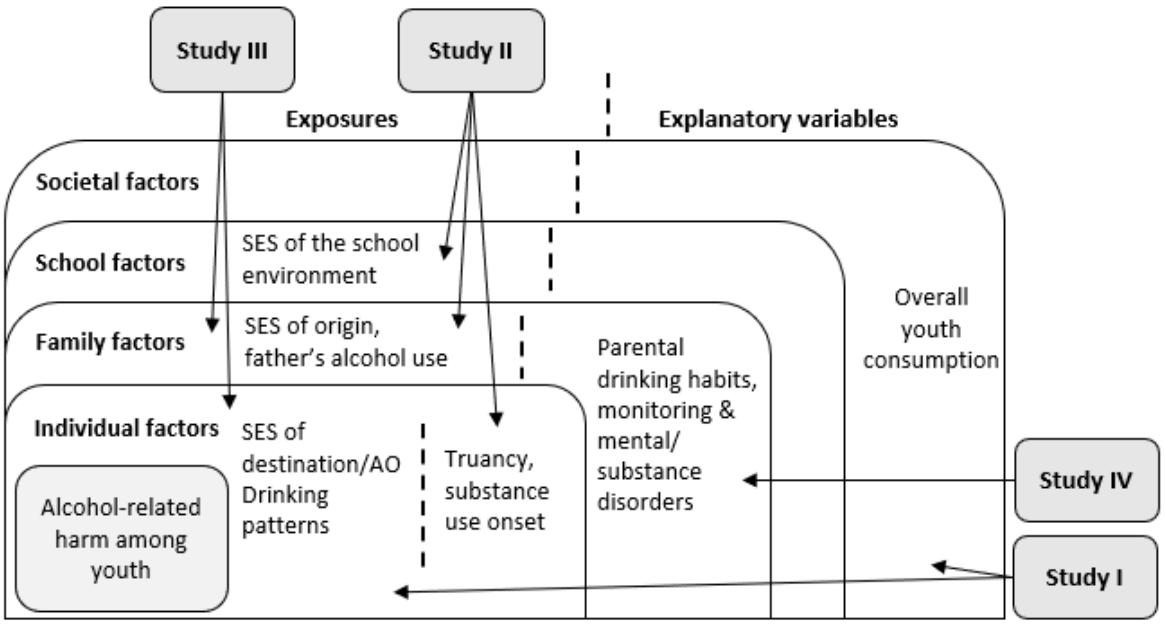
Thus, overall, the association between SES and alcohol consumption has been extensively researched in the young population (Boden and Fergusson, 2011; Bye and Rossow, 2010; Kraus et al., 2009), although with contradictory results (Hanson and Chen,

2007a). Fewer studies have focused on the association between SES and ARH. These alternative ways of measuring SES among adolescents may be an important piece of the puzzle to understand social inequality in ARH among young people. The fact that evidence obtained in the adult population shows a direct association between SES and harm, even after adjustment for drinking patterns, implies that lower SES groups have an elevated risk of experiencing harm at a given level or pattern of drinking (Laatikainen et al., 2014; Makela and Paljarvi, 2008; Syden et al., 2017). Therefore, it is of importance to study the association between SES and ARH also among adolescents.

Moreover, there is limited understanding of what factors might contribute to the social gradient in ARH among young people. For example, research has shown that lower parental education is associated with higher levels of truancy (Modecki et al., 2014), and students with high truancy rates tend to engage in more harmful drinking and experience more ARH than their peers (Mounteney et al., 2010). Additionally, it is plausible that there is unequal exposure to other risk factors related to ARH such as harmful levels and patterns of drinking, and early onset of substance use across different SES groups (Schmidt et al., 2010; Thor and Gripe, 2022).

2.5 Summary of conceptual framework

Against this background, it is evident that ARH among youth may be affected by SDH that act at different levels in society. Below is a scheme influenced by the work of Dahlgren and Whitehead (2007) on the main determinants of health, and Kaplan's work on health inequality in welfare states (Kaplan, 2007).



The scheme aims to contextualise and enhance the understanding of ARH among youth and the SDH that influence it by providing an overview of both downstream (individual behaviours e.g. alcohol use) and upstream factors (e.g. SES) included in this thesis and positioning the various exposures and explanatory variables of each study within this framework.

3 Research aims

The overall aim of the thesis was to explore various previously understudied aspects of the epidemiology of ARH among adolescents. To this end, the four included studies focus on the associations of different exposures with the risk for ARH among adolescents. The exposures include: (i) individual levels and patterns of drinking; (ii) different indicators/measures of SES; and (iii) fathers' drinking habits. With the intent to explore the mechanism and pathways underlying the above associations, the studies also assess the possible importance of various confounding, mediating and moderating factors.

Study I: Examines the association between the trend in self-reported ARH and the trend in alcohol consumption during 1995–2012, among young Swedish alcohol consumers. Further, we tested whether the strength of the association between individual level self-reported alcohol consumption and ARH is affected by the overall level of consumption among youth.

Study II: Examines how SES among youth is related to self-reported HED and ARH using three SES indicators: (i) SES of origin (parental education level); (ii) SES of the school environment (average parental education level at student's school); and (iii) SES of destination (academic orientation). In addition, we adjust for factors that might mediate the main associations, including levels and patterns of drinking, truancy and parental monitoring.

Study III: Aim to increase our understanding of the social gradient in self-reported ARH among youth, by studying not only students in VP and HEP but alco including students in IP. We also assess to what extent the above relationship may be explained by (i) an elevated prevalence of other risk factors among students in the IP and VP, such as HED, problematic parental alcohol consumption, truancy, age of onset for substance use etc., or (ii) if the effect of HED is modified by study programme in such a way that HED has a stronger association with ARH among students in the IP or VP in comparison to students in HEP programme.

Study IV: Investigates how fathers' alcohol use is related to the risk for SRD in children, during youth and young adulthood. More specifically, we assess how the risk for SRD in children 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 SES, fathers' low emotional control and parental mental and substance-related disorders (measured among both mothers and fathers).

4 Materials and methods

The following section contains an overview of study design, data, variables and main analysis of each respective study. The data stem from three cross-sectional school surveys with mainly self-reported responses and one prospective cohort study with both self-reported responses and registered linked data.

Table 1. An overview of the four studies included in the thesis.

	Study I	**Study II**	**Study III**	**Study IV**
Design	Swedish cross-sectional school survey (n=68 863) 1995-2012	Swedish cross-sectional school survey (n=4448) 2015-2016	Swedish cross-sectional school survey (n=3044) 2021	Prospective cohort study (n=64 710) 1969/70, follow-up 1982-2009
Exposures	Volume of consumption, HED, Heavy drinkers top 5%	SES of origin (individual level), SES of environment (school environment), SES of destination (academic orientation)	Academic orientation	Fathers' volume of alcohol consumption, frequency of intoxication, apprehension for drunkenness, alcohol-related disorders
Outcome	Self-reported alcohol-related problems and HED	Self-reported alcohol-related problems and HED	Self-reported alcohol-related problems	Alcohol and drug-related disorders (among the children)
Main analysis	Negative binominal regression models with robust estimates to account for students being clustered in school classes.	Multilevel logistic regression was used in the models for HED. Multilevel negative binomial regression was applied to alcohol-related problems.	Negative binominal regression models, with cluster option to account for students being clustered in school or school classes.	Cox regression models, with cluster option to account for the children being clustered on the fathers.
Explanatory variables	Level of overall youth consumption as possible moderating variable	Volume of alcohol, HED, parental monitoring, truancy	HED, parental problematic alcohol consumption, truancy, age of onset for substance use, family-satisfaction	Fathers' low emotional control & psychiatric diagnosis. Mental and substance-related disorders in both father and mother. Childhood SES.

4.1 School surveys

Three of the four studies were based on data from school surveys conducted by the Swedish Council for Information on Alcohol and Other Drugs (CAN). A stratified sampling procedure is used, to ensure that all regions in Sweden are represented, and school class, rather than pupil, is used as the sampling unit, i.e., if a class is drawn then all the students in that class fill out a questionnaire. The survey is an anonymous questionnaire completed in the classroom. As part of processing, survey responses that were incomplete or appeared exaggerated were excluded.

4.1.1 Data for study I

Data were retrieved from the annual cross-sectional survey among 15- to 16-year-olds for the years 1995 to 2012, which corresponds to when the same set of questions about ARH were included in the survey.

The total sample consisted of 98 780 students aged 15 to 16 years. The analytical sample of current alcohol consumers consisted of 68 863. The sample was weighted by gender and region.

The participation rate on class level was between 80 and 96% and the response rate on student level was between 83 and 93% (Zetterqvist, 2022).

4.1.2 Data for study II

Data were retrieved from the annual cross-sectional survey among 17- to 18-year-olds. The dataset consisted of 8257 upper secondary school students. The analytical sample consisted of those who were alcohol consumers and had completed all of the survey items included in the study, resulting in 4448 students. The sample was weighted by gender and region.

The participation rate on class level was 79% in 2015 and 81% in 2016 and the response rate on student level was 82% in 2015 and 81% in 2016 (Zetterqvist, 2022).

4.1.3 Data for study III

The study was based on two cross-sectional datasets. Both surveys were conducted in 2021 by CAN.

Dataset (1) was the 2021 wave of the Swedish national school survey among 17–18-year-old students and weighted by gender and region.

The second dataset (2) consists of data from the IP in upper secondary school. To avoid survey units that were so small as to threaten the students' sense of anonymity, only schools with at least 20 students enrolled in the IP were included in the sampling frame. The survey was offered to all students in the randomly selected IP. The survey in IP was

designed to generate results comparable to those from the yearly Swedish national school survey (i.e. dataset 1). The sample was weighted by gender.

The participation rate in dataset (1) among second-year students in national programmes was 74% on the class level and the response rate on student level was 81% (Thor and Gripe, 2022). The participation rate in dataset (2) in the IP was 56% on class level and 67% on student level (Thor and Gripe, 2022). The analytical sample consisted of alcohol consumers who had completed all of the survey items included in the study: 2124 students in HEP programmes, 676 students in VP and 244 students in IP.

4.1.4 Measurements study I, II and III, exposures and outcome

4.1.4.1 SES of destination/academic orientation, exposure in study II and III

Information on SES of destination/academic orientation in upper secondary school was on group level and received from each school before participating in the survey. Included in study II were HEP and VP. Study III included the two aforementioned programmes as well as IP.

4.1.4.2 SES of the school environment, exposure in study II

Information on SES of the school environment was on group level and obtained from Statistics Sweden (SCB). It comprises the proportion of students at each annual class level with at least one parent with post-secondary education. The measure was divided into three categories.

4.1.4.3 SES of origin/parental SES, exposure in study II

Information on parental SES was reported by the student. The measure was created using the questions 'Has your mother/father studied at university or college?'. The questions were coded into two categories (i) at least one parent has studied at university/collage and (ii) neither parent has studied at university/college.

4.1.4.4 Volume of alcohol consumption, exposure in study I and explanatory variable in study II

Volume of consumption over the last 12 months was measured using a beverage-specific quantity and frequency scale which was summed up in litres of 100% alcohol. This measure thus combines questions on how often spirits, wine, beer, and cider have been consumed and the typical amount consumed per occasion. The consumed quantity was multiplied by the alcoholic strength of each beverage (taken from registered sales); this gives a measure of the respondent's total alcohol consumption in litres of pure alcohol per year.

4.1.4.5 Heavy episodic drinking, exposure in study I, and explanatory variable in study II and III

Heavy episodic drinking (HED) was measured by a question regarding whether the student on one occasion has drunk an amount of alcohol equivalent to at least a whole bottle of wine or four cans of strong beer/mixed drinks or six cans of medium strength beer (3.5%vol) or 18 cl spirits. Those who reported such consumption at least once a month were considered heavy episodic drinkers.

4.1.4.6 Heavy drinkers top 5%, exposure in study I

Heavy drinkers were defined as the top 5% consumers, each year.

4.1.4.7 Self-reported alcohol-related harm, outcome in study I, II and III

Self-reported ARH was measured with a question about how many times the respondents had experienced problems related to their drinking. The question, 'Have you experienced any of the following problems due to your drinking of alcohol?' followed by a list. The items included in the list have changed over the years; table 2 shows which items were included in each study.

4.1.4.8 Statistical analyses

Since the respondents are clustered in school classes and in schools the assumption of independence between observations was violated, which was taken into consideration in each study.

Table 2. Self-reported alcohol-related problems in the school surveys.

Same for all three studies
Quarrel Physical fight Accident or injury Ruined clothes or other belongings Problems with relations to parents Problems with relations to friends Trouble with the police Lost money or valuables Victim of robbery of theft *.+ in study I*
Engaged in sex that you regretted Engaged in sex without a condom Poor school or work performance Problems with relations to teachers *.+ in study II & III*
Deliberately harmed yourself Deliberately harmed someone else Victim of violence Engaged in sexual intercourse that you regretted the next day Riding a moped or other motor vehicle with a drunk driver Driving a moped or other motor vehicle Gone swimming in deep waters *.+ in study III*
Been photographed/filmed in an embarrassing or humiliating situation

4.2 Military conscript survey

4.2.1 Data study IV

The fourth study was based on a prospective cohort with a study population of 64 710 Swedish citizens 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. 2).

Conscripts for military service were only males during these years. At the time no more than 2–3% of all Swedish men were exempted from conscription, and in those cases mainly due to severe handicaps or congenital disorders (Andréasson, 1990). At conscription, the men 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). During the years 1969/70 the men also met with a psychologist for a structured interview and asked to participate in a survey consisting of two questionnaires.

One of the questionnaires included questions concerning substance use, for example alcohol consumption, while the other covered social background, psychological factors and health etc. (Andréasson, 1990).

The follow-up period spanned between the years 1982 and 2009, and information on substance-related disorders (SRD) during these years in the children was obtained by record linkage with the NCD and NHD Registers. Childhood SES was retrieved from the 1985 and 1990 census.

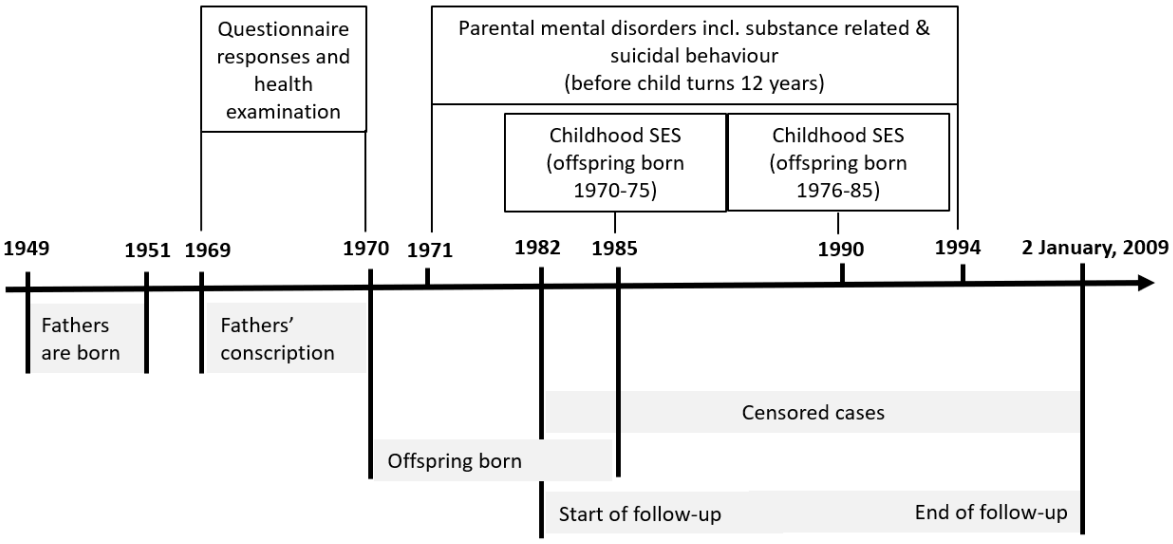


Figure 2. The timeline of the cohort shows when the fathers were born, when they were conscripted and completed surveys, when their children were born and the time-span of follow-up through record linkage with the NCD and NHD Register.

4.2.2 Measurements study IV, exposures and outcome

Information on the father's alcohol consumption, frequency of intoxication and apprehension for drunkenness was measured by questionnaire responses at fathers' conscription.

4.2.2.1 Volume of consumption, exposure in study IV

Volume of consumption was measured with a frequency and quantity scale and summed into grammes of 100% alcohol consumed per week, and coded into five quintiles plus a sixth category consisting of abstainers.

4.2.2.2 Frequency of intoxication, exposure in study IV

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'.

4.2.2.3 Apprehension for drunkenness, exposure in study IV

Apprehension for drunkenness was measured by the question: 'Have you ever been apprehended for drunkenness?' This question produced four categories: 'Abstainers', 'Consumer but never been apprehended for drunkenness', 'Apprehended for drunkenness once' and 'Apprehended for drunkenness several times'.

4.2.2.4 Alcohol-related disorders in the fathers, exposure in study IV

Alcohol-related disorders that led to hospitalisation or mortality in the father before the child was 12 years old. Information on mortality was obtained by record linkage with the NCD Register, and alcohol-related diagnoses by record linkage with the NHD Register (ICD-8).

4.2.2.5 Substance-related disorders in the children, outcome in study IV

Information on hospitalisation and mortality among the children owing to SRD was obtained by record linkage with the NCD and NHD Registers. We included alcohol- and drug-related diagnoses from ICD-8/9/10. 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.

4.2.2.6 Statistical analyses

Cox regression models with cluster option (to account for children being clustered on the fathers) were used to estimate hazard ratios and 95% confidence intervals. Person-time was calculated from the time the individual turned 12 years of age until the first

event of substance-related hospitalisation or mortality, reaching age 40 years, death or end of follow-up in 2009.

4.3 Ethical considerations

Three of the four studies were based on data from cross-sectional surveys with anonymous respondents covering a large geographical area. Thus, no individuals can in any way be identified. However, respondents may find it unpleasant or privacy-infringing to answer questions about their lifestyle and alcohol habits. Furthermore, there is a certain risk that participation feels forced when the survey is conducted in the classroom. To minimise this risk, students are informed of how they can easily opt out without having to show it to the teacher or classmates. Students are also informed that they can skip individual questions if they wish.

One of the studies is based on data from the military conscript study with self-reported data as well as medical examinations and follow-up by register linked data about the original respondents, their children and the children's mothers. Testing at the conscription for military was typically used to allocate men to different positions in the military, according to their capabilities. By linking this data to register data from the NCD Register and the NHD Register a unique and valuable data was created. Ethical queries at baseline data collection could be that both questions and medical examinations might have been perceived as unpleasant or intrusive for the respondents although participation was voluntary (Andréasson, 1990).

A possible benefit for the research subjects may be that they are given a chance to reflect on their own alcohol habits. The benefit of being asked questions about sensitive areas should not be underestimated. The studies derived from the data in this thesis have good prospects for contributing to a greater understanding of young people's alcohol habits and related harm, which in the long run may have implications for policy, resource distribution and prevention.

5 Results

The results of the four studies included in the thesis are presented below.

5.1 Overall alcohol consumption and alcohol-related harm among youth in Sweden, study I

Study I explored how the trend in self-reported ARH among adolescent alcohol consumers in Sweden followed the trend in overall youth alcohol consumption during 1995–2012. In a second step we tested whether or not the strength of the individual - level relationship between consumption and harm was related to overall level of youth consumption.

Figure 3 shows the development of overall mean alcohol consumption, HED and mean number of experienced ARH among consumers, during 1995-2012. The average number of ARH more or less followed the changes in consumption, apart from the fact that the shifts over time for mean number of problems are less distinct than the changes in consumption.

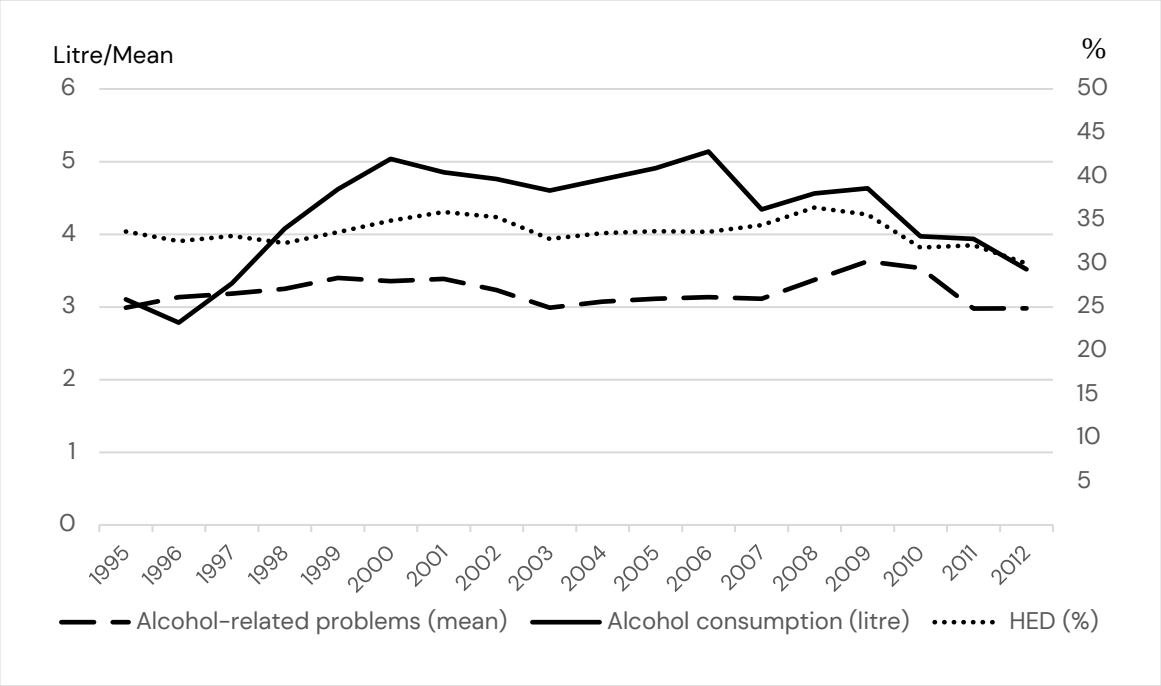


Figure 3. Mean number of alcohol-related problems (left axis), alcohol consumption litre of pure alcohol (left axis) and percentage of HED (right axis), among consumers.

Between the years 1995 and 2000 there was an increase in consumption that coincided with a 12% increase in mean number of problems. Furthermore, the decrease in alcohol consumption from 2000 to 2003 also corresponded with an 11% reduction of mean number of problems. However, the trends in HED correspond more clearly to the changes in mean number of problems.

Table 3 tells us that a 10% increase in volume of consumption was associated with an increase of approximately 5-6% in number of ARH. The table also reveals that the association between ARH and the different measures of consumption and drinking patterns, are roughly the same over time. Consequently, there are no signs that the individual-level associations between alcohol use and ARH would be affected by changes in the overall mean youth consumption.

Table 3. Regression estimates of the relationship between alcohol-related harm and alcohol consumption, HED and heavy drinking. Among consumers.

Year	Alcohol mean volume[a]			HED			Heavy drinkers (top 5%)		
		95% CI			95% CI			95% CI	
	RR	Lower	Upper	RR	Lower	Upper	RR	Lower	Upper
1995	0.59	0.55	0.62	4.11	3.75	4.51	4.02	3.61	4.47
1996	0.52	0.49	0.56	3.80	3.49	4.14	3.84	3.48	4.24
1997	0.61	0.58	0.64	4.00	3.66	4.38	4.42	3.97	4.93
1998	0.57	0.54	0.60	3.74	3.42	4.09	3.43	3.09	3.82
1999	0.57	0.54	0.60	3.88	3.57	4.22	3.76	3.35	4.21
2000	0.56	0.52	0.59	3.61	3.28	3.97	3.39	3.01	3.81
2001	0.57	0.54	0.60	3.87	3.56	4.20	4.15	3.75	4.58
2002	0.55	0.52	0.58	4.04	3.72	4.39	4.10	3.71	4.53
2003	0.58	0.54	0.61	4.12	3.75	4.54	3.89	3.44	4.39
2004	0.53	0.50	0.57	4.29	3.89	4.72	4.74	4.23	5.32
2005	0.54	0.51	0.57	4.22	3.84	4.63	3.97	3.57	4.42
2006	0.58	0.56	0.61	4.64	4.20	5.12	4.76	4.22	5.37
2007	0.54	0.50	0.58	3.98	3.57	4.43	4.05	3.56	4.61
2008	0.52	0.49	0.56	4.31	3.88	4.79	4.32	3.80	4.91
2009	0.55	0.52	0.59	4.37	3.93	4.85	4.00	3.50	4.58
2010	0.53	0.49	0.58	4.19	3.78	4.65	4.63	4.09	5.23
2011	0.53	0.50	0.56	3.99	3.56	4.47	3.77	3.22	4.42
2012	0.55	0.52	0.58	3.77	3.34	4.25	3.75	3.20	4.40

All models yielded significant estimates ($p<0.001$), RR, rate ratios; CI, confidence interval

[a]log transform consumption

5.2 Social inequalities in harmful drinking and alcohol-related harm among Swedish adolescents, study II and study III

The aim of study II was to examine how SES among youth is associated to HED and ARH using three measures of SES: (i) SES of origin, (ii) SES of the school environment and (iii) SES of destination (also called AO). The overall aim of study III built on study II by examining the social gradient in ARH by AO among young alcohol consumers, after also including students enrolled in the IP. To further strengthen the approach, factors that might explain the associations between the SES indicators and ARH were adjusted for.

The first outcome that was investigated in study II was HED and the results showed that SES of destination/AO was the only indicator significantly associated with HED, indicating that students in VP were more likely to engage in HED, OR= 1.42, 95% CI 1.13–1.80 (see table 3 in paper II). For the outcome ARH, the estimates for SES of destination/AO RR=1.25 and SES of the school environment RR=1.19 suggested more ARH in VP and in schools with lower-educated parents, see table 4.

Table 4. The association of SES with alcohol-related harm. Among consumers. Multilevel negative binomial regression. Study II.

	Model 1		Model 2		Model 3	
	RR	95% CI	RR	95% CI	RR	95% CI
Female (ref. male)	0.99	0.90-1.09	1.00	0.92-1.10	1.23	1.13-1.33
SES of origin - Individual level						
At least one parent studied at college	ref		ref		ref	
Neither mother nor father studied at college	0.92	0.82-1.03	0.89	0.79-0.99	0.90	0.81-0.99
SES of environment - Group level- proportion of tertiary education among parents						
Schools with highest proportion	ref		ref		ref	
Schools in the middle category	1.04	0.91-1.20	1.05	0.91-1.20	1.09	0.97-1.22
Schools with lowest proportion	1.19	1.02-1.39	1.17	1.01-1.36	1.20	1.06-1.37
SES of destination - Group level						
Higher education preparatory	ref		ref		ref	
Vocational programme	1.25	1.08-1.45	1.27	1.10-1.47	1.07	0.94-1.21
Covariates						
Parents offering alcohol (ref. no)			1.41	1.29-1.54	1.19	1.10-1.28
Knowledge of whereabouts (ref. yes)			1.69	1.41-2.02	1.39	1.18-1.63
Truancy (ref. no)			1.91	1.72-2.12	1.57	1.43-1.72
Volume of alcohol					1.06	1.05-1.07
Heavy episodic drinking					1.98	1.80-2.16

RR, rate ratios; CI, confidence interval

After adjusting for volume of alcohol and HED (model 3), SES of the school environment still displayed a negative and significant estimate while the estimate for SES of destination became non-significant.

The results in study III revealed a negative graded association between AO and ARH. That is, in the crude model (only adjusted for gender) the levels of ARH differed across AO with 45% higher levels of ARH among students in VP compared to HEP and 77% higher levels of ARH among students in IP compared to HEP (see Table 5).

Furthermore, while adjusting for HED attenuated the amount of ARH in VP IRR= 1.31, it did not do so for the IP IRR=1.89. Adjusting for all explanatory variables suggested a 62% reduction of ARH in VP and a 44% reduction in IP, in comparison to the crude model.

Both multiplicative and additive interaction between AO and HED was tested to determine if the association between HED and ARH is modified by AO. There were no indications of interaction on the multiplicative scale. A variable comprised by AO and HED was created to enable testing for interaction on the additive scale. The variable demonstrated a gradual increase of ARH across AO. Compared to students in HEP without HED, students in HEP with HED reported five times higher level of ARH, and students in VP and IP who engaged in HED obtained even larger estimates, with the latter group reporting eight times higher levels of ARH. Furthermore, students in VP and IP who did not engage in HED experienced more ARH compared to students in HEP who did not engage in HED. Students who did not engage in HED in the IP reported almost three times more problems compared to HEP students without HED, IRR=2.81 (table 4 in paper III).

The RERI calculation (RERI = IRR++ – IRR+- – IRR-+ + 1) was used to perform the additive interaction test (table 4 in paper III). The RERI estimates indicated a positive additive interaction for the double exposure of students in VP who engaged in HED, which suggests that 1.40 of the IRRs for students in VP engaged in HED, was attributed to an interaction of being exposed to both HED and a lower AO. In the full model the RERI was not significant for either combination.

Table 5. The association of academic orientation with alcohol-related harm. Among consumers. Negative binomial regression. Study III.

		IRR[a]	95% CI	Attenuation[b]
	Crude model (adjusted for gender)			
	Vocational	1.45	1.23-1.71	
	Introductory	1.77	1.42-2.22	
+	HED (model 2)			
	Vocational	1.31	1.13-1.51	31
	Introduction	1.89	1.47-2.44	-16
+	Truancy (model 3)			
	Vocational	1.40	1.18-1.66	11
	Introductory	1.51	1.18-1.94	34
+	Substance onset<14 y old (model 4)			
	Vocational	1.29	1.09-1.52	36
	Introductory	1.38	1.09-1.74	51
+	CAST6 + family discontent (model 5)			
	Vocational	1.37	1.16-1.62	18
	Introductory	1.67	1.32-2.12	13
+	Combined/full model			
	Vocational	1.17	1.01-1.36	62
	Introductory	1.43	1.08-1.90	44

a) IRR, incidence rate ratio, for alcohol-related problems when adding variables separately to the crude model. CI, confidence interval

b) Percentage attenuation (IRRcrude-IRRadjusted)/(IRRcrude-1) × 100.

5.3 Fathers' alcohol consumption and risk of substance-related disorders in children, study IV

The main aim of the fourth study was to explore how different dimensions of fathers' alcohol use were related to the risk for SRD in their children during youth and young adulthood.

The results indicated that an increase in each indicator of father's alcohol use corresponded to a greater risk for SRD in children. For the exposure father's volume of consumption, the risk that children would have SRD ranged between HR=1.11 for quintile 1 and HR=2.02 for quintile 5 (table 6). Children whose fathers had been apprehended for drunkenness several times (HR=4.28) or had alcohol-related disorders (HR=4.47) demonstrated the highest risk for SRD relative to those whose fathers reported abstinence. The covariates explained roughly 40-70% of the association, depending on which outcome one looks at. After adjustments, the highest risk was still found among children whose fathers had been apprehended for drunkenness or had received an alcohol-related diagnosis, with a more than two-fold increased risk for SRD. However,

those with fathers in the highest alcohol consumption quintile still had a 63% higher risk (HR=1.63) compared to those whose fathers reported abstinence. Among those whose fathers reported frequent intoxication, the risk in the fully adjusted model was still 49% higher (HR=1.49) compared to those whose fathers reported abstinence.

Table 6. Cox regression analysis to assess the association between father's alcohol use and SRD among the children. Adjusted for child's sex and year of birth.

	Model 1		**Fully adjusted Model**	
	HR	95% CI	HR	95% CI
Volume of consumption				
Abstainers (ref.)	ref.		ref.	
1	1.11	0.84-1.45	1.09	0.83-1.43
2	1.30	0.99-1.70	1.28	0.98- 1.67
3	1.35	1.04-1.77	1.32	1.01-1.72
4	1.41	1.09-1.84	1.33	1.02-1.73
5	2.02	1.56-2.62	1.63	1.26-2.12
Frequency of intoxication				
Abstainers (ref.)	ref.		ref.	
Consumer but never intoxicated	1.15	0.86-1.53	1.13	0.85- 1.51
Rarely	1.41	1.10-1.81	1.33	1.04-1.71
Often/quite often	1.81	1.38-2.36	1.49	1.14-1.95
Appreh. For drunkeness				
Abstainers (ref.)	ref.		ref.	
Consumer never apprehended	1.33	1.03-1.70	1.28	1.00-1.63
Apprehended once	2.21	1.65-2.94	1.73	1.30-2.32
Apprehended ≥ twice	4.28	3.12-5.86	2.39	1.71-3.33
Alcohol-related disorders				
Abstainers (ref.)	ref.		ref.	
Consumer but no alcohol-related disorder	1.36	1.06-1.75	1.33	1.04-1.70
Alcohol-related disorder	4.47	3.31-6.03	2.09	1.50-2.91

HR, Hazard ratios; CI, confidence interval

6 Discussion

The aim of the thesis was to improve our knowledge of aspects of ARH among adolescents and young people in Sweden. Main findings and concluding remarks are presented below.

6.1 Main findings

6.1.1 Changes in overall alcohol consumption and alcohol-related harm among youth in Sweden

During the 1990s a large proportion of Swedish adolescents were alcohol consumers but at the turn of the century the levels started to decline. In relation to this, study I aimed to assess whether the decrease in youth drinking was followed by a corresponding decrease in prevalence of self-reported ARH, and whether the decreasing overall youth consumption affected the individual level associations between alcohol use and related harm.

The main finding from study I was that adolescent alcohol consumers experience about the same number of ARH from their alcohol consumption, irrespective of the level of aggregated overall mean consumption. In other words, the associations between individual alcohol use and ARH stayed the same in the period of high as well as low aggregated mean alcohol consumption. Hence, the finding does not lend support to the normalisation theory.

An earlier Norwegian study (Bye and Rossow, 2008) including 15- to 20-year-olds, found support for a weakening in the association between alcohol consumption and alcohol-related violence during a period marked by high consumption. In addition, a Swedish study (Landberg and Hubner, 2014) on the adult general population also found a weakening in the relationship between consumption and a wider range of problems, during a period of high consumption. Findings from the present study do not support previous conclusions. However, a few differences are evident. The present analysis is on the age group 15–16-year-olds while the other studies include much wider age spans. In addition, the previous studies have studied periods with differences in volume of consumption or intoxication, whereas the periods in our study differ mainly in changes in drinking participation which in turn is reflected in the overall consumption in the entire youth group. In view of that, our aim was to study how the relationship between alcohol consumption and ARH is related to the overall mean consumption during a period of changes in the proportion of alcohol consumers.

While there is no established threshold for at what prevalence denormalisation of alcohol use would occur, a proportion of 40% or more has been viewed as an indication of normalisation (Parker et al., 2002; Sznitman et al., 2013; Sznitman et al., 2016). Seeing

that the lowest prevalence of alcohol consumers (measured in 2012, the most recent year included in the study) totalled 56%, it is conceivable that the lack of evidence for a change in the association between alcohol use and harm in this study, could be due to the fact that alcohol use was still relatively widespread. Accordingly, it could be debated whether the behaviour of drinking alcohol was still too common to indicate a denormalisation of alcohol use. However, a recent study examining markers of normalisation or denormalisation in several countries including Sweden, suggests that existing research on the decline in youth alcohol drinking participation indicates a denormalisation of alcohol consumption among youth (Caluzzi et al., 2022).

Lastly, the results demonstrated that HED showed a closer association to the development of ARH among adolescent alcohol consumers, than did the measure of overall consumption. This supports previous research suggesting that HED has a stronger influence on ARH among adolescents than does the total volume of consumption (Andersson and Hibell, 2007; Danielsson et al., 2012; Rossow et al., 2013).

The findings that the studied indicators of alcohol use are important exposures to ARH among adolescents, regardless of how normalised the behaviour is in the youth population, together with previous studies demonstrating that youth consumption has changed collectively during this period, lend support the notion that ARH among adolescents can be targeted through universal efforts aimed at the overall level of youth drinking. Findings from the study do however also suggest that efforts targeting reduced HED among youth could have an even bigger impact on combating ARH among adolescents.

6.1.2 Socio-economic differences in alcohol-related harm among adolescents

The potential links between social inequality and ARH have not been explored as much among young people as in the general population. Among adults, it is established that groups with low SES have an increased risk of ARH (Mackenbach et al., 2015; Probst et al., 2014). The effects of social inequalities are less apparent in the prevalence of drinking and/or harmful alcohol use among adults (Probst et al., 2020); and most previous studies on the youth population have focused on these indicators, and not on ARH.

Findings from study II indicated that the SES gradient among youth is stronger for ARH than for HED, which is in line with findings from the general population (Mackenbach et al., 2015; Probst et al., 2014).

SES of destination (also called AO) was the only SES indicator significantly associated to HED, with higher odds of HED for students in VP. However, both AO and SES of the school environment were associated to ARH, implying that students in VP and students from schools with a low proportion of advanced education among the parents experienced more ARH compared to the reference groups.

The findings of study II thus demonstrated that including ARH as an outcome is important for understanding alcohol-related behaviour among youth and that focusing exclusively on SES differences in adverse drinking patterns might result in underestimations of the social inequality in ARH. The findings also added support to the idea that the environment matters for social inequalities in alcohol use and in ARH among youth (Olsson and Fritzell, 2015).

The findings from study III expanded on those of study II by demonstrating the graded association between AO and ARH when a more complete sample of adolescents was included. That is, the results indicated a negative gradient in the association between AO and ARH, where students enrolled in IP experienced the highest levels of ARH in comparison to students in HEP. Our study thus adds to previous literature that disadvantaged groups experience the most ARH also among youth (Probst et al., 2014). There was also a higher amount of ARH among students in VP in comparison to students in HEP, supporting previous findings from study II.

In both studies the social inequalities in ARH could largely be attributed to an unequal exposure to risk factors, such as HED (study II and III), truancy (study II and III) and early onset substance use (study III).

An interesting finding in study III was that adjustment for HED resulted in attenuations similar to those found for the adult population (Probst et al., 2020) for students in VP, whereas no such attenuation was found for the IP students. Still, nearly half of the high levels of ARH among IP students could be attributed to differential exposure to risk factors other than HED. This may indicate that this group is more likely to appear in settings involving deviant behaviours, such as altercations with peers or police, getting injured or robbed or being a victim of violence. If this is the case, the elevated levels of ARH reported by IP students could be attributed to an increased risk or experiencing such problems in the first place, implying that the group would report higher levels of problems compared to less disadvantaged peers also at a similar level of drinking or HED.

Overall, the findings from study II and III are in line with previous research on the adult population showing that the SES gradient is stronger for ARH than for harmful drinking (Probst et al., 2020). Both SES of the environment and AO showed a negative association to ARH. In addition, when IP students were added to the analyses the negative gradient in risk of ARH persisted. Also in line with studies of the adult population, was the fact that a large part of the excess risk among VP students was explained by differences in HED (Probst et al., 2020). However, among students in IP, HED seems to be a less important factor in this context.

6.1.3 Substance-related disorders among children whose parents have problematic alcohol use

How children are affected by parents with alcohol problems has been well researched (Johnson and Leff, 1999). However, only a few studies have explored how parental alcohol use affects the children, when the use is below sub-clinical levels (i.e. the parent has not received an alcohol-related diagnosis). This is particularly true in regard to studies exploring the long-term or severe consequences for the children of sub-clinical alcohol users.

Findings from study IV revealed that all dimensions of fathers' alcohol use included in the study were related to a gradually increased risk of SRD up to young adulthood among the children. As expected, the highest risk for SRD was discovered among children whose fathers exhibited more severe indicators of alcohol use, e.g. alcohol-related disorders or fathers' self-reports of being apprehended for drunkenness.

However, there was an increased risk for SRD also among children whose fathers had reported lower levels of alcohol consumption. Hence, even though the risk among children with fathers who had reported sub-clinical drinking was lower in comparison to children whose fathers had received an alcohol-related diagnosis, the children with fathers who drink at a sub-clinical level accounted for a much larger proportion of all cases of SRD in the population.

The findings support previous studies that have demonstrated an association between a crude measure of fathers' alcohol consumption and long-term harm among the children both regarding alcohol-related disorders (Hemmingsson et al., 2017; Holst et al., 2019) and mortality (Landberg et al., 2018). The findings add to previous knowledge by demonstrating how the fathers' alcohol consumption at different levels, including sub-clinical levels, is associated with SRD among their children, both boys and girls.

Furthermore, the findings indicated that the associations to a large extent could be explained by risk factors in childhood that tend to cluster with problematic drinking among parents. Consequently, adjusting for all explanatory variables explained about half of the associations between the measures of father's alcohol use and children's SRD. However, a large part of the elevated risk for SRD among the children remained, implying an independent effect on SRD among the children.

The findings therefore suggest that the fathers' alcohol use, including sub-clinical use, can be considered an important exposure for later substance-related problems among the children.

6.2 Methodological considerations

6.2.1 Strengths and limitations

Most study designs, if not all, are related to different kinds of biases. The studies included in this thesis used cross-sectional and prospective cohort designs. One potential cause of bias in this context might be that the respondents are underestimating their alcohol consumption (Midanik, 1982). Another is that respondents do not remember how much alcohol they have had or, in the studies based on the Swedish national school surveys, if they have experienced any ARH.

The limitations of cross-sectional data are well known. Data on both exposure and outcome are gathered at one moment in time, which means that one can only draw conclusions based on associations: it is not possible to identify causality (Aschengrau, 2008). In contrast to cross-sectional data, in a prospective design, information on the exposure is collected before the outcome has occurred.

Another potential source of bias that could affect data from the Swedish national school surveys (and not so much in this particular prospective cohort study) concerns the fact that not all of the classes included in the sample actually participate; nor do all students in participating classes actually participate. The risk for bias lies in the fact that students who do not participate might have a different set of risk factors or sociodemographic characteristics (Dawson et al., 2014). Analysis of the Swedish school survey has, however, shown that the coverage of sociodemographic characteristics is representative despite not all classes participating (Englund, 2014; Zetterqvist, 2022). Moreover, even though students who were not present at the time of the original survey show higher consumption of substances than their classmates who were present (Andersson and Hibell, 1993) previous analysis shows that this has very little impact on the results. An important strength of the Swedish national school survey is the high consistency of data collection. The survey has been conducted by the same organisation, CAN, using the same methodology, across the entire study period, and when several years are included in a study the questions are unaltered.

The prospective cohort study, on the other hand, consists of all men who in 1969/70 participated in conscription for military training. Since very few men were exempted from conscription the coverage is likely very good. Limitations in the cohort study concern the fact that the father's alcohol consumption, although reported by the father himself, is reported in early adulthood and not necessarily at the time when his child was growing up. Moreover, information on whether the child grew up with the father in question is lacking. The study would also benefit from having information on the mother's self-reported alcohol use.

6.2.2 Confounding

To reduce for confounding bias, most analyses in the four studies include adjustments for covariates. However, it is not assumed that all confounding effects are accounted for.

7 Conclusions

A number of overall conclusions can be drawn. First, all studies in the thesis found significant associations between the studied exposures and ARH in young people. Additionally, even after adjustment for explanatory factors, both individual levels and patterns of drinking, as well as indicators of fathers' alcohol use, remained significantly associated with ARH. These findings suggest that these indicators can be regarded as robust and independent exposures related to ARH.

Second, among the indicators of SES, both SES of the environment and SES of destination/academic orientation appear to have a negative association with ARH, and a negative gradient in the strength of the association is revealed when students in IP are included in the analysis. Still, while some of these associations can be attributed to differential exposure to HED, other risk factors also contribute to the gradient, particularly among the most disadvantaged group of students, i.e. those in IP.

Third, in line with the SDH framework, the overall findings of the thesis demonstrate how exposures and risk factors on different levels, e.g. drinking habits (both the young people's own and their fathers'), as well as individual, parental and school-level SES are associated with risk of ARH among young people and also tend to contribute to the social gradient of this outcome.

In addition to these overall conclusions, the findings of the thesis show that the social gradient among young people is stronger for ARH than for harmful drinking. Thus, research focusing solely on the associations between SES and harmful drinking patterns may underestimate the social inequalities in ARH among young people. Furthermore, children whose parents have received an alcohol-related diagnosis run a greater risk than their peers of ending up with a SRD of their own. Nonetheless, a large proportion of the SRD cases in the population are found among the children whose fathers have exhibited problematic drinking behaviours without receiving an alcohol-related diagnosis.

8 Implications and future directions

The overall aim of the thesis was to explore various previously understudied aspects of the epidemiology of ARH among young people. The four included studies focus on the associations of different exposures with the risk for ARH among adolescents. With the intent to explore the mechanisms and pathways underlying the associations, the studies also assess the possible importance of various confounding, mediating and moderating factors.

Since alcohol use and related harm are preventable, the findings from the thesis bear important implications for public health policy and prevention.

Findings presented in the thesis reinforce existing knowledge by indicating that reduced drinking, among both young people and their parents (i.e. fathers) likely would reduce harm related to drinking among young people. The findings have also added to previous understanding by demonstrating how a significant proportion of SRD cases in the population are found among children whose fathers have exhibited problematic drinking behaviours, yet without an alcohol-related diagnosis. Thus, the implications of the results support the notion that universal alcohol policies targeting the level of overall alcohol consumption in society may be used to reduce ARH among young people. In addition, targeting HED among youth specifically, might yield positive results on ARH since the results indicate a close relationship between HED and ARH among youth.

Previous research in the general population have shown a social gradient in ARH across SES groups (Hemström, 2002; Makela and Paljarvi, 2008) and the findings from this thesis have expanded on that knowledge by illustrating a social gradient in ARH across youth groups with different academic orientations. Thus, efforts to reduce youth drinking overall should be complemented with prevention efforts targeting students in the most disadvantaged groups and the children of fathers with the most problematic alcohol use. It is therefore important to supplement the universal efforts with efforts that are aimed at the most vulnerable groups. Studies have also demonstrated that protective factors related to the school, like a positive and encouraging environment, might compensate for risk factors related to alcohol use among youth such as problematic parental drinking (Olsson et al., 2018; Olsson et al., 2021). The school arena therefore has potential to work as an equalising factor for SDH related to ARH among youth.

Future research should take into consideration that the adolescent's own SES might be an important predictor of ARH, and should therefore be included as an indicator. In particular, AO has been shown to be an important indicator of adolescent ARH. The findings of the present thesis and previous research (Probst et al., 2020) also illustrate

the importance of not only focusing on differences in SES and harmful drinking, but also including ARH, so as not to underestimate the social inequalities in ARH among youth.

Most of the studies in this thesis have used cross-sectional design. The benefits of cross-sectional studies are many, mainly related to availability and cost-effectiveness. However, to gain a greater understanding of to which extent associations are confounded by unmeasured factors, research on ARH among youth would benefit by being complemented with longitudinal studies.

Future research should prioritise identifying the pathways and mechanisms that lead to increased ARH among adolescents in the most disadvantaged groups. With fuller understanding of these factors, interventions can be developed that specifically address the unique challenges faced and help mitigate the negative consequences of alcohol use.

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