LUND UNIVERSITY

Substance use in adolescents and young adults: Interactions of drugs of abuse and the role of parents and peers in early onset of substance use

Berge, Jonas

2015

Substance use in adolescents and young adults
Interactions of drugs of abuse and the role of parents and peers in early onset of substance use

JONAS BERGE | FACULTY OF MEDICINE | LUND UNIVERSITY

Substance use in adolescents and young adults

Interactions of drugs of abuse and the role of parents and peers in early onset of substance use

Jonas Berge

Organization	Document name
LUND UNIVERSITY	DOCTORAL DISSERTATION
Faculty of Medicine, Department of Clinical Sciences, Lund, Division of Psychiatry	
	Date of disputation 2015-12-11
Author(s): Jonas Berge	Sponsoring organization

Title and subtitle   Substance use in adolescents and young adults: Interactions of drugs of abuse and the role of parents and peers in early onset of substance use

Abstract

Background: Misuse of substances is a major contributor to disability and mortality worldwide. The use of tobacco, alcohol, and illegal drugs in adolescence and young adulthood are well-known risk factors for subsequent substance-related harms. A better understanding of adolescent and young adult substance use behaviors and their correlates might help develop new prevention programs. This thesis aims to explore patterns of use and important risk factors for substance use among Swedish adolescents and adults.

Materials and methods: The papers in this thesis are based on three data sets. The first is from a survey on substance use habits in the Swedish general population, answered by 22,095 individuals in the ages 15-64. The second data set comes from a cohort of 1,398 adolescents and their parents, followed during the course of junior high school. The third data set is a cross-sectional online survey of 1,916 Swedish and Danish young adults in the ages 18-30. The study participants were asked about current substance use habits, and retrospective reports on adolescent risk behaviors.

Results: The first paper shows that adult cannabis users use other substances more compared to non-users. Frequent cannabis users were more likely to use illicit drugs, but reported much lower levels of hazardous alcohol use. In the second paper, it was found that the parents of Swedish adolescents were largely unaware of their children's substance use behaviors. In the third study, we found that parental substance use and provision of alcohol were more influential on the adolescents' substance use than parenting styles. In the fourth study, the importance of adolescent risk behaviors for subsequent patterns of substance use in young adulthood was confirmed.

Conclusions: Parents typically know little about their children's substance use, and the influence of parents regarding adolescent substance use is limited. However, providing the children with alcohol is a common parenting practice that is associated with increased substance use in adolescence. Lastly, there is a need for further research on different groups of cannabis users that may have different needs for prevention and intervention efforts.

Key words   Substance use, Alcohol, Tobacco, Cannabis, Illicit drugs, Adolescents, Young adults
Classification system and/or index terms (if any)

Supplementary bibliographical information	Language English

ISSN and key title 1652-8220	ISBN 978-91-7619-212-2
Recipient's notes	Number of pages 105	Price
	Security classification	

I, the undersigned, being the copyright owner of the abstract of the above-mentioned dissertation, hereby grant to all reference sources permission to publish and disseminate the abstract of the above-mentioned dissertation.

Signature   Date   2015-11-05

Substance use in adolescents and young adults

Interactions of drugs of abuse and the role of parents and peers in early onset of substance use

Jonas Berge

LUND
UNIVERSITY

To my daughter Celia

List of papers

This thesis is based on the following papers.

I. Alcohol and drug use in groups of cannabis users: results from a survey of drug use in the Swedish general population. Berge, J; Håkansson, A; Berglund, M. Am J Addict. 2014, 23(3):272-9.

II. Parental awareness of substance use among adolescents in a junior high school sample. Berge, J; Sundell, K; Öjehagen, A; Höglund, P; Håkansson, A. Journal of Drug Issues. 2015, 45(3):263-278.

III. The Role of Parenting Styles in Adolescent Substance Use: Results from a Swedish Longitudinal Cohort Study. Berge, J; Sundell, K; Öjehagen, A; Håkansson, A. Accepted. BMJ Open.

IV. The impact of early onset of adolescent risk behaviors on substance use in young adulthood. Berge, J; Abrahamsson, T; Dahlman, D; Öjehagen, A; Håkansson, A. Submitted manuscript.

Reprints were made with permission from the respective publishers.

Contents

Introduction

The non-medical use of psychoactive substances, such as alcohol, tobacco, cannabis, and other licit and illicit drugs, is a major contributor to harm to individuals and society at large. In a study on data from the 2010 Global Burden of Disease Study (Whiteford et al. 2013), it was estimated that mental health and substance use disorders, combined, was the leading cause of years lived with disability worldwide. Alcohol and illicit drug use disorders, not including harmful use or abuse, accounted for 20.5 percent of the disability adjusted life years (DALY) among mental health and substance use disorders (Whiteford et al. 2013), and tobacco use is one of the most important contributors to disability and death worldwide (Forouzanfar et al., 2015). Drug use, especially opioid use disorders, is one of the leading avoidable causes of mortality among young people in Europe, and most studies show mortality rates of 1-2 percent per year among problem drug users (EMCDDA, 2015).

Given the scope of the problem it would seem that efficient prevention would be of great importance, to the individual as well as to society. The use of tobacco, alcohol, and illicit drugs often starts during adolescence (Hibell et al., 2012; Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2015), and many intervention programs focus on adolescents and their families under the assumption that if early onset of substance use can be prevented or delayed, the risk of problematic substance use and its consequences can be reduced (Jackson, Geddes, Haw, & Frank, 2012; Hale, Fitzgerald-Yau, & Viner, 2014). However, while there is evidence for the efficacy of a number of different intervention programs targeted at minimizing adolescent substance, the effect sizes are generally small and the evidence for long-term benefits is scant (Jackson et al., 2012; Hale et al., 2014). A better understanding of the complex pathways to onset of and progression in substance use in adolescence is thus desirable, as this might facilitate the development of new intervention programs.

The four papers included in this thesis aim to examine patterns of substance use in adolescents and young adults, to add knowledge on pathways to onset of substance use in adolescence and the progression of substance use from adolescence to adulthood. In the first paper, different groups of adolescent and adult cannabis users are examined with respect to use of other substances and demographic data. The second paper focuses on parental knowledge of adolescent substance use, and factors that are associated with parental knowledge. In the third paper, the impact

of general style of parenting, a concept called parenting style, on subsequent adolescent substance use, or progression of use, is studied using a longitudinal study design. In the last paper, the associations between risk behaviors in adolescence and substance use in young adulthood are studied.

Substance use in Sweden

In a recent Swedish population survey of 28,000 adults in the ages 19 to 70, four percent met DSM-IV criteria for alcohol dependence (Andréasson, Danielsson, & Hallgren, 2013). In the age group of 19 to 25, 54 percent met at least one of the DSM-IV criteria for alcohol dependence (three or more required for diagnosis) and eleven percent met the criteria for alcohol dependence. In the latest data from the Swedish National Survey of Public health (Public Health Agency of Sweden, 2015), twelve percent of all individuals in the ages 16 to 84 years had ever used cannabis, and four percent had used other illicit drugs. Among the youngest age group, 16 to 29 years, twenty percent had ever used cannabis and seven percent had used illicit drugs (Public Health Agency of Sweden, 2015).

In 2015, among Swedish adolescents at 15 to 16 years of age, 44 percent of the girls and 40 percent of the boys reported having used alcohol in the past twelve months (Swedish Council for Information on Alcohol and Other Drugs [CAN], 2015). A total of eight percent of the girls and nine percent of the boys reported monthly binge drinking, defined as consuming a whole bottle of wine or comparable amounts of other alcoholic beverages on one occasion. Fourteen percent of the girls and ten percent of the boys reported cigarette smoking. A total of five percent of the girls and eight percent of the boys in the age range 15 to 16 years reported lifetime illicit drug use, mainly accounted for by cannabis use. In the past ten years, there has been a statistically significant downward trend in alcohol and cigarette use among adolescents in all ages, and the levels of illicit drug use has been relatively stable during this period (CAN, 2015).

Substance use in adolescents and young adults

Adolescence is a period of transition from childhood to adulthood. Adolescents undergo changes in physical, psychological and social functioning during these formative years, and forming new friendships, romantic relationships, and seeking new interests and activities are hallmarks of this developmentally intense period of life (Adams & Berzonsky, 2005). It is therefore perhaps not surprising that young people get in contact with substances of misuse during this period of their lives, and that some choose to experiment with tobacco, alcohol, and illicit drugs.

Alcohol is the most commonly used intoxicating drug among adolescents (Hibell et al., 2012; Johnston et al., 2015). Though most countries apply a minimum legal age for buying alcohol (World Health Organization [WHO], 2014), it is reasonable to assume that the legal status of alcohol, compared to cannabis, contributes to its widespread use among adolescents. Alcohol has been ranked as one of the most harmful drugs (Nutt, King, & Philips, 2010; van Amsterdam, Nutt, Philips, & van den Brink, 2015), and WHO estimated that in 2012, six percent of all global deaths were attributable to alcohol (WHO, 2014). The average drinking volume, i.e. the average amount of alcohol consumed per day, and the drinking pattern, i.e. amounts of alcohol consumed on a single day or drinking occasion, have both been associated with alcohol-related harms (Dawson, 2011). Binge drinking, also called heavy episodic drinking, is often defined as five drinks for men in a single day and four drinks for women in a single day, and has been shown to be associated with alcohol-related harms independent from average amount of alcohol consumed (Dawson, 2011). Among Swedish adolescents in the ages 15-16 years, about 44 percent of the girls and 40 percent of the boys have used alcohol, and binge drinking in the past month was reported by eleven percent of both girls and boys (CAN, 2015).

Cannabis is the most commonly used illicit drug among adolescents (Hibell et al., 2012; CAN, 2015; Johnston et al., 2015). Cannabis has been ranked as less harmful than alcohol (Nutt et al., 2010; van Amsterdam et al., 2015), but is nevertheless associated with social, psychological, and physical harms (Hall, 2009). Among the harms identified are: development of dependence, injury or death in traffic accidents, cardiovascular disease, impaired respiratory functioning and, perhaps most important, negative consequences on adolescent cognitive functioning and mental health (Hall, 2009). As with alcohol, there are clear associations between frequency of use and the risk for adverse consequences (Hall, 2009). It is estimated that, among Swedish adolescents aged 15-16 years, five percent of the girls and eight percent of the boys have ever used illicit drugs, and two percent have used illicit drugs in the past 30 days (CAN, 2015).

There is a well-documented temporal association between alcohol use and later cannabis use (Hall & Pacula, 2003), but relatively little is known about how the frequency of cannabis use is related to alcohol use and the use of other illicit drugs. In a study of the general Canadian population, it was found that high frequency of cannabis use was associated with a lower rate of alcohol use in the past 12 months, but also associated with a higher rate of daily alcohol use and use of other illicit drugs (Fischer et al., 2010). In another study, of UK adolescents, higher frequency of cannabis use was associated with higher consumption of alcohol and with more use of other illicit drugs (Miller & Plant, 2002). In a prospective study, it was found that young Australian adults who used cannabis weekly were more likely to initiate subsequent high-risk alcohol use than those who used cannabis less often (Swift, Coffey, & Degenhardt, 2012). These

disparate results are difficult to interpret, and the bidirectional associations between alcohol use and cannabis use warrant further exploration since adolescents and young adults commonly use these substances.

Initiation of substance use in early adolescence is one of the most important risk factors for later substance use disorders (Grant & Dawson, 1997; Grant, 1998; Grant & Dawson, 1998; Meyers & Dick, 2010; Windle & Windle, 2012; Spear, 2015). For example, Grant and Dawson (1997) reported that adolescents who initiate alcohol use before the age of 14 are at a four-fold risk of subsequent alcohol dependence compared to those who start drinking after the age of 20. DeWit, Adlaf, Offord, and Ogborne (2000) found that initiation of alcohol use at ages 11-14 years is associated with a much higher risk than initiation later in adolescence. A similar pattern can be seen for tobacco. In a longitudinal cohort study with 6,929 individuals in the analyzed sample, it was found that 72 percent of those who started smoking cigarettes in adolescence progressed to regular smoking (Chassin, Presson, Pitts, & Sherman, 2000). Earlier onset of smoking was associated with earlier onset of daily smoking and higher amounts of cigarettes smoked per day (Chassin et al., 2000). The same associations can also be seen for illicit drug use. For example, it has been demonstrated that early and frequent use of cannabis is associated with persistent use and a more rapid progression to cannabis-related harms (DeWit, Hance, Offord, & Ogborne, 2000; Chen, Storr, & Anthony, 2009; Windle & Windle, 2012), and initiation of illicit drug use in adolescence, compared to initiation in adulthood, is associated with a higher risk of experiencing drug dependence problems across several categories of illicit drugs (Chen et al., 2009).

There has been considerable discussion of the so-called "gateway effect". This refers to an observed pattern of substance use initiation in which adolescents progress from the use of tobacco and alcohol to cannabis and other illicit drugs (Hall & Pacula, 2003; Degenhardt, Dierker, & Chiu, 2010). A number of studies confirm that using one type of substance is associated with subsequent use of other types of substances. For example, Ellickson, Tucker, and Klein (2003) found that drinking alcohol in 7th grade was associated with a range of adverse substance use outcomes in grade 12 and at the age of 23. McGee, Williams, Poulton, and Moffitt (2000) found that alcohol and tobacco use habits are associated with subsequent cannabis dependence. Windle and Windle (2012) found that early onset of alcohol use was associated with subsequent symptoms of alcohol, tobacco, cannabis, and cocaine dependence, and early onset of cigarette use or cannabis use were both independently associated with subsequent symptoms of both tobacco and cannabis dependence (Windle & Windle, 2012). The focus of the debate on the "gateway effect" has been the underlying causes of the observed pattern of substance use initiation, especially the observation that initiation of cannabis use is clearly associated with subsequent drug use disorders (Hall & Pacula, 2003; Degenhardt et al., 2010). One perspective is that the early use of substances alters the reward

14

system in the brain, making it more susceptible to the rewarding effects of other drugs. Another perspective is that to use cannabis, the adolescent has to buy it from drug dealers and he/she is thereby exposed to other illicit drugs. A third perspective is that the same intra-individual factors (e.g. genetic, psychological, or social factors) are associated with both experimentation with cannabis and experimentation with other drugs, and that the observed relationship is not causal at all (Degenhardt et al., 2010).

Substance use during adolescence not only increases the risk of subsequent substance use, substance use disorders, and associated risks, but is also associated with lower academic achievement (Miller & Plant, 1999; Ellickson et al., 2003; Fergusson & Boden, 2008; Latvala et al., 2014), internalizing problems such as depressed mood and anxiety (Trim, Meehan, King, Chassin, 2007), employment problems (Ellickson et al., 2003; Fergusson & Boden, 2008), disinhibitory psychopathology such as antisocial personality disorder and delinquency (Ellickson et al., 2003), and worse general young adult functioning (Chassin, Pitts, & DeLucia, 1999; Fergusson & Boden, 2008; Englund et al., 2013).

These relationships are of course not just causal associations, but parts of a complex constellation of problems, which are interrelated and multifactorial. For example, the relationship between early substance use initiation and lower academic achievement may be bidirectional, as several studies have indicated that lower school performance is also associated with early onset of substance use (Hall, 2009; Hayatbakhsh, Najman, Bor, Clavarino, & Alati, 2011; Latvala et al., 2014). However, some studies indicate that experimental substance users, compared to abstainers, may have a higher chance of attaining higher education (Englund et al., 2013). It has been argued that there are common causes that affect both levels of alcohol use and level of educational attainment, which explain these associations, rather than being directly causal (Chatterji, 2006).

Risk factors for adolescent substance use

Substance use in adolescence is a complex phenomenon. There is ample evidence to support influence from genes, prenatal factors, family environment, psychological traits, peers, and other factors of influence (Allen, Donohue, Griffin, Ryan, & Turner, 2003; Baer, Sampson, Barr, Connor, & Streissguth, 2003; Ryan, Jorm, & Lubman, 2010; Becoña et al., 2012). An exhaustive review of this broad field of research is outside the scope of this thesis, but a brief overview of some important aspects that influence adolescents' propensity to use substances follows.

The role of parents

Parents naturally have a central role in their children's lives, and can, as family environment overall, influence their behavior in many ways. Generally speaking, the influence of parents is greatest in young children, and tends to diminish as the children grow up. In many ways, the influence from peers tends to dominate in adolescence (Kandel, 1985). Nevertheless, the family remains one of the major social contexts that influence adolescents' decisions concerning the use of substances (Hawkins, Catalano, & Miller, 1992; Bahr, Marcos, & Maughan, 1995; Barnes, Reifman, Farrell, & Dintcheff, 2000; Guo, Hawkins, Hill, & Abbott, 2001; Latendresse et al., 2009). The family influences the adolescent's decisions to use substances in a variety of ways, including clear and specific rules prohibiting substance use, consistent consequences for violating the rules, and monitoring of the children's behavior, all of which have been demonstrated to be related to lower level of alcohol use in adolescents (Chilcoat & Anthony, 1996; Barnes et al., 2000; Kosterman, Hawkins, Guo, Catalano, & Abbott, 2000; Nash, McQueen, & Bray, 2005). However, the role of specific rules on alcohol use remains unclear. In a systematic review from 2012, the authors failed to find evidence of a positive effect of specific rules on alcohol use either on age of initiation of alcohol use or levels of alcohol consumption (Ryan et al., 2010). Positive parental attitudes on adolescent alcohol use, for example if parents think it's acceptable for adolescents to be drunk, or think it's acceptable as long as they drink at home, are directly or indirectly communicated to children by their parents, and are linked to greater risk of substance use in adolescents (Hawkins et al., 1992; Foley, Altman, Durant, & Wolfson, 2004). Children also model their parents' behavior, the majority of studies on the issue having found that parents' alcohol consumption is associated both with earlier onset of alcohol use in adolescence and with levels of alcohol use later in life (Hawkins et al., 1992; Hill, Shen, Lowers, & Locke, 2000; Ryan et al., 2010).

Somewhat in the line of thinking of harm-minimization theory, supervised drinking has been suggested as possibly giving adolescents the opportunity to learn to drink in a responsible manner, and although this may somewhat increase the underage use of alcohol, it may reduce the risk of the adolescents progressing to more problematic drinking during late adolescence and early adulthood (McMorris, Catalano, Kim, Toumbourou, & Hemphill, 2011). However, although the results in the scientific literature have been mixed, most studies seem to indicate that parental provision of alcohol is related to earlier age of initiation of alcohol use as well as higher levels of alcohol use (Jackson, Henriksen, & Dickinson, 1999; Ryan et al., 2010; McMorris et al., 2011).

Another aspect of parenting is parental knowledge about adolescent activities. A higher level of parental knowledge of adolescent activities has been associated with lower rates of adolescent substance use, lower rates of delinquency, and

lower rates of association with deviant peers (Fosco, Stormshak, Dishion, & Winter, 2012; Lippold, Coffman, & Greenberg, 2014). Many of the prevention programs at the family level target parental knowledge by aiming to improve parent-child communication and improve family management strategies (Greenberg & Lippold, 2013; Hale et al., 2014). Parental awareness about adolescent substance use is naturally required for parents to actively try to change the substance-related behavior of their children. It would thus seem to be important to assess the extent of parental awareness and what factors influence parental awareness of adolescent substance use. For example, in a study based on 985 Canadian youths and their parents, it was found that the parents generally underestimated their children's substance use (Williams, McDermitt, Bertrand, & Davis, 2003). Parental awareness of their children's use of tobacco and alcohol use were 41 and 37 percent, respectively. Parental awareness of illicit drug use was only 13 percent. It was also found that higher adolescent age, better school performance, and parental substance use were associated with parental awareness. In a study on 483 Dutch families (Engels, Van der Vorst, Dekovic, & Meeus, 2007), it was found that adolescent weekly alcohol consumption was known to 20 to 35 percent of the parents, and drinking at least four glasses of alcohol per week was known to 16 to 49 percent of the parents. Further, they found that frequency and quantity of alcohol use, as well as higher adolescent age, were associated with parental knowledge. In another study of 2015 Taiwanese adolescents and their parents, 6.3 percent of the parents whose children reported alcohol use were aware of the alcohol use and 32 percent were aware of their children's tobacco use (Chang et al., 2013). Adolescent delinquency, parental alcohol use, lower parental age, and lower parental education were associated with lower rates of parental awareness of adolescent alcohol use, and lower parental education, parental tobacco use, adolescent academic performance below average, and delinquent behaviors were associated with parental awareness of adolescent tobacco use (Chang et al., 2013).

While specific factors related to substance use are of obvious importance, another consideration, that has received much attention, is the general style of parenting in the family. Baumrind, in the early 60's, used naturalistic observation and parental interviews to identify three main parenting styles, based on two different aspects of parenting, which encompassed the majority of families (Baumrind, 1967). The demandingness aspect refers to the extent to which the parent expects mature behavior and exerts control over and monitors the behavior of the child. The responsiveness aspect represents the extent to which the parent expresses emotional warmth in the relationship with the child, and is responsive to the needs of the child. Authoritative parenting, one of the three major styles of parenting identified by Baumrind, is characterized by a high degree of demandingness combined with a high degree of responsiveness. These parents are responsive to the needs and feelings of their children while they are also demanding and attempt

to direct their child's behavior in a rational manner, and reason with their child in issues concerning the family and the child. Authoritarian parents, characterized by a high degree of demandingness and a low degree of responsiveness, are controlling, believe in keeping the child in place, and do not encourage verbal give and take, expecting the child to accept their word for what is right. Permissive parenting is characterized by a high degree of responsiveness and a low degree of demandingness. Permissive parents are accepting and non-punitive. They make few demands on their children and avoid exercising of control, while also being emotionally attached and emotionally warm towards their children (Baumrind, 1967). In 1983, Maccoby and Martin made a significant contribution to the Baumrind's model by separating neglectful parenting style from the permissive parenting style (Maccoby & Martin, 1983). Neglectful parenting style, also called uninvolved or indifferent, is characterized by a low degree of both demandingness and responsiveness. These parents have a low level of emotional commitment to their children and have little time or attention to spare for the child. They make few demands on their children and exert a low degree of enforcement, and seek to minimize the time for and efforts of interaction with the child. Starting with the works of Baumrind (Baumrind, 1971), it has then repeatedly been demonstrated that authoritative parenting is associated with a higher degree of child and adolescent competence, performance and psychosocial maturity compared to permissive, authoritarian or indifferent parenting. Although methodologies have varied, the combination of high parental responsiveness and high demandingness has consistently been associated with better adolescent adjustment, school performance and psychosocial maturity (Steinberg & Morris, 2001). The four-fold classification of Maccoby and Martin has been greatly influential in research on the relationship between parenting styles and adolescent and young adult substance use starting with the work by Lamborn, Mounts, Steinberg, and Dornbusch (1991). In this study, indulgent and neglectful parenting styles were found to be correlated with drug use. While other attempts have been made to conceptualize parenting styles, including expanding the number of types and using specific scales for each parenting style category, the four-fold classification based on a two-dimensional factor structure has become prominent in research on adolescent substance use (Becoña et al., 2012; Čablová, Pazderková, & Miovský, 2014).

Parenting styles were initially often defined by parental reports. Previous research indicates that parenting styles as perceived by adolescents may be more accurate in predicting outcomes than parenting styles as perceived by parents (Chassin et al. 2005). This might be because parents may be biased towards describing their parenting style in a more socially desirable manner. Much of the research on associations between parenting styles and substance use in the past two decades has therefore been based on children's reports (Becoña et al., 2012).

In a recent review (Becoña et al., 2012), it was found that most studies report lower rates of substance use among adolescents with authoritative parents and higher rates among adolescents with neglectful parents. For example, in a longitudinal study on Scottish adolescents, among those aged 15 to 16 years at baseline, authoritative parenting was associated with less probability of frequent drinking than the average at follow-up two years later, and permissive and neglectful parenting styles were associated with higher probability of frequent drinking at follow-up (Shucksmith, Glendinning, & Hendry, 1997). In a longitudinal study on 347 Icelandic youths aged 14 at baseline, parental smoking, but not parenting styles, predicted smoking at follow-up three years after baseline assessment (Adalbjarnardottir & Hafsteinsson, 2001). Furthermore, adolescents with authoritative parents were less likely to have drunk alcohol and to engage in heavy drinking than those with neglectful parents, and less likely to have tried cannabis and amphetamine than those with neglectful parents (Adalbjarnardottir & Hafsteinsson, 2001). In a large study of more than 2,000 adolescents, it was shown that having an authoritative mother, compared to having a neglectful mother, was associated with lower probability of the adolescent having being drunk in the past year, but there was no such association with having engaged in binge drinking in the past year (Shakya, Christakis, & Fowler, 2012). Furthermore, having substance-using peers at baseline was associated with all subsequent substance use outcomes. Chassin and colleagues found that, in a sample of 382 adolescents, disengaged parenting style (equivalent to neglectful) was associated with cigarette use at follow-up (Chassin et al. 2005). Though there are many more studies on this topic, most of them are cross-sectional, and few of them include several other important risk factors such as peer influence, delinquency, parental substance use, and specific rules on substance use (Becoña et al., 2012).

The role of peers

As children grow older, peers become more and more important to the children, and will start to influence them in many aspects of life. When focusing on substance use, the influence of parents seems to gradually diminish after early adolescence in favor of influence from other sources such as peers (Allen et al., 2003; van der Zwaluw et al., 2008). Indeed, peer substance use and peer delinquency and other deviant behavior have consistently been found to influence adolescent concurrent as well as future substance use (Barnow et al., 2004; Simons-Morton, 2004; Branstetter, Low, & Furman, 2011; Marschall-Levesque, Castellanos-Ryan, Vitaro, & Seguin, 2014). In a meta-analysis based on, in total, 108 studies (Allen et al., 2003), it was found that there is a large overall effect of the influence of peers on substance use, including tobacco, alcohol, cannabis and other illicit drugs. The effect was largest for cannabis, while being somewhat lower for alcohol than for the other substance use categories. It was concluded

that, although the influence of peer behavior and attitudes was overall more important than the influence of parents for substance use outcomes, parents remain an important source of influence (Allen et al., 2003).

Individual factors

While family environment and influence from peers undoubtedly are important for a young person's propensity to experiment with substances, as well as to progress to more regular use, individual characteristics also play a major role. Individual characteristics that might be important in this regard are, for example: personality traits, disruptive behavior disorders such as conduct disorder (CD) and oppositional defiant disorder (ODD), and neurodevelopmental disorders, such as attention-deficit/hyperactive disorder (ADHD). Conduct disorder is a persistent pattern of disruptive behavior, starting in childhood or adolescence, and characterized by violation of basic rights of others and of societal norms (American Psychiatric Association 2013). There are well-established links between CD and later substance use (Flory & Lynam, 2003; Sartor, Lynskey, Heath, Jacob, & True, 2007), and there is a considerable co-morbidity between CD, ODD, ADHD, and antisocial personality disorder (Loeber, Burke, Lahey, Winters, & Zera, 2000), all of which are also associated with an increased risk of substance use outcomes (Flory & Lynam, 2003; Fenton et al., 2012; Sloboda, Glantz, & Tarter, 2012). For example, in a prospective study of 671 young adults (Windle & Windle, 2012), it was found that property damage and starting fights during adolescence were independently related to later alcohol disorder symptoms. Palmer and colleagues (2013) found that adolescent conduct disorder and novelty-seeking behaviors predicted substance dependence in young adulthood. In a 2011 review of longitudinal studies on the association between childhood ADHD and subsequent substance use, children with ADHD were more likely to report nicotine, alcohol, or drug dependence in adulthood (Lee, Humphreys, Flory, Liu, & Glass, 2011). The authors conclude that while the association between ADHD and substance use outcomes is a robust finding in the literature, it might be inflated to some degree by co-morbid ODD/CD, which has considerable co-morbidity with ADHD (Loeber et al., 2000; Barkley, 2006; Lee et al., 2011).

The role of genes

Another major contributor to the inter-individual variability in substance use and substance dependence is the genetic constitution of the individual (Meyers & Dick, 2010; Sloboda et al., 2012). Taking alcohol dependence as an example, twin and adoption studies have quantified the heritable component at 50 to 60 percent (Kendler, Heath, Neale, Kessler, & Eaves, 1992; Prescott & Kendler, 1999;

Meyers & Dick, 2010). Since substance use disorders are, to a substantial degree, influenced by genetic factors, and parents with substance use disorders have a lower level of functioning as parents (Solis, Shadur, Burns, & Hussong, 2012), separating different effects is obviously difficult. Furthermore, ADHD, childhood CD and antisocial personality disorders have all been shown to have strong genetic components (Hofvander, Ossowski, Lundström, & Anckarsäter, 2009; Freitag, Rohde, Lempp, & Romanos, 2010; Gunter, Vaughn, & Philibert, 2010), and this also contributes to the complexity of the issue. The topic of this thesis is associations between substance use behaviors and behavioral and environmental factors, and while genetic factors doubtlessly exert a significant influence, discussing this issue further is outside of the scope of this thesis.

Prevention

As stated previously, substance use and substance use disorders are among the major contributors to mortality and morbidity globally. Societies thus need to adapt strategies on several levels to try to lessen the negative consequences of substance use and misuse. Sweden has adopted rather strict policies on alcohol, tobacco, and illicit drugs. Like in many European countries, using cannabis and most other drugs is illegal. Two factors that set Sweden apart from most other European countries in this regard is including prison in the punishment scale for use of illicit drugs, which allows the police to demand urine or blood samples from individuals suspected of drug use, and the police authorities' focus on strict enforcement of the illicit drug use laws on the drug users themselves (Olsson et al., 2011; Svensson, 2012).

Another societal effort to reduce the consequences of substance use and misuse are by broad prevention efforts directed at specific levels. Prevention and intervention programs for young people are often targeted at schools, family, and the community. In a recent systematic overview, it was found that effect sizes for intervention programs targeted at these levels generally were small, although some studies reported moderate effect sizes (Hale et al., 2014). For school based intervention programs, 32 studies were included in the systematic review, and 18 showed significant effects for at least two substances. The most effective interventions targeted several components and aimed to strengthen the adolescents' refusal skills. The majority of intervention programs recognized the influence of peers in risky behavior. Family-based intervention was assessed in six studies included in the systematic overview and though most of the effect sizes were small, all of them showed some effect on at least one of the substance use outcomes. Finally, five studies that assessed four community-based interventions were included in the review, and all of them had small, but significant effects on

substance use outcomes. It is concluded that the evidence is strongest for those intervention programs that target common risk factors for a range of health behaviors (Hale et al., 2014), and a similar conclusion is drawn in another systematic review (Jackson et al., 2012).

Rationale for the thesis

The widespread use of psychoactive substances is a source of major concern not only on a societal level but also for individuals who suffer the consequences of their own or their relatives' substance misuse. There are ongoing multidisciplinary research efforts on issues related to substance use, for example in the clinical, epidemiological, neurobiological, psychological, and sociological fields of research. This broad scope of scientific focus is needed because these are issues that not only have a major impact on individuals and the society at large, but they are also multi-faceted and highly complex. Since patterns of substance use in adolescents and young adults are influenced by cultural context in terms of cultural patterns of substance use, national and local policies on substance use, and availability of substances at different ages, there is a need to study these phenomena from a national perspective. An increased level of knowledge about patters of substance use and related phenomena in adolescents could potentially influence decisions in the context of primary and secondary prevention programs as well as policy decisions.

Aims

General aim

Alcohol, tobacco, and cannabis are the most frequently used psychoactive substances among adolescents and young adults. While there is a large body of scientific literature on the general topics of substance use in adolescence and young adulthood, the papers in the present thesis aimed to further explore patterns of use and important risk factors for substance use among Swedish adolescents and young adults.

Study-specific aims

Study I

The aim of this study was to describe the association between past-year cannabis use and hazardous alcohol use in the general Swedish population, and to evaluate the association between frequency of cannabis use and hazardous alcohol, when adjusting for a range of confounding variables.

Study II

This study aimed to assess what parents know about their adolescent children's use of cigarettes, alcohol, and illicit drugs, and to identify factors that are associated with parental knowledge.

Study III

In this study the aim was to assess the potential importance of parenting styles at the start of junior high school, for the development of different substance use behaviors at the end of junior high school, when taking other potentially confounding variables into consideration.

Study IV

In the final study, the primary aim was to retrospectively assess the potential importance of problem behaviors in early adolescence for a range of substance use behaviors in young adulthood.

Materials and methods

Study design

All of the four papers included in this thesis can be said to reflect different aspects of the Swedish general population to some extent. The first paper was based on a national survey of the Swedish general population of the ages 16-64 years and the data are weighted to provide a nationally representative sample. The second and third papers were based a sample of 1,398 adolescents, and their parents, from 21 junior high schools. The study participants were followed for over 2.5 years during the course of junior high school, and assessed with questionnaires at several different occasions during this period of time. While the schools were not selected as to be nationally representative, the sample is nevertheless large and might be compared to the general population of Swedish adolescents in junior high school. The fourth paper was based on an online survey of Danish and Swedish adults, 18-30 years of age, from the main metropolitan areas of each country. The study designs of the four papers are summarized in table 1:

	Study I	Study II	Study III	Study IV
Design	Cross-sectional	Cross-sectional	Prospective	Cross-sectional
Follow-up time	-	-	32 months	-
Sample	Swedish general population, age 15-64	Swedish parent-adolescent pairs. Adolescents' age 13-16	Swedish adolescents aged 12-13 at baseline	Swedish and Danish young adults, aged 18-30
Sample Analyzed in main analyses	19,226	244-474	917-986	1,810-1,903
Statistical methods	Logistic regression	Logistic regression	Principal component analysis, logistic regression, generalized additive model.	Quasi-binomial regression

Table 1. Summary of general aspects of study designs and samples in each paper.

Study I

The first study is based on a survey on alcohol and drug habits in the Swedish general population, conducted in 2008-2009 (Swedish National Institute of Public Health [FHI], 2010). The study was designed in collaboration between FHI and researchers of Lund University.

The sampling process was conducted by stratified probability sampling, using all registered residents in Sweden in the age range specified above as the sampling frame. The selection of potential study participants was thus randomized within different strata, with an over-sampling of younger individuals, people living in urban areas and males, because these groups were assumed to have lower response rates and are more likely to use illicit drugs. Study participants were given sample weights corresponding to the degree of over-sampling within each stratum, and these weights were used in calculating the rates of substance use in the general population. The study participants received no monetary compensation for participating in the study. By responding to the questionnaire, the study participants also agreed to let researchers access registry data from the National Registry of the Total Population. These data were added to the questionnaire data in the final data set.

Study II and study III

The second and third studies are based on data from a longitudinal quasi-experimental study of students and their parents from 21 Swedish junior high schools, conducted in 2004-2007 (Ferrer-Wreder, Sundell, Eichas, Habbi, & Beheshti, 2015). The National Drug Policy Coordinator and the Alcohol Committee, two governmental organizations that supported schools in the prevention of alcohol and drug use at the time, initiated the project. As was discussed in the introduction section, there are a number of evidence-based programs for prevention of substance use and other problem behaviors in adolescence (Jackson et al., 2012; Hale et al., 2014). The rationale behind the original study was that the strict protocols of the programs in the studies might differ from real-world implementations of these methods, and the original study thus aimed to study the effects of evidence-based prevention programs as used in a naturalistic setting.

Study IV

The fourth study was based on data from the *EU Meds Study*, a cross-sectional multi-national study of European adolescents and adults conducted in 2014. Shire LLC, a pharmaceutical company that markets a drug used in the treatment of

ADHD, funded the study. RTI International, an independent, non-profit research institute, collaborated with groups of local researchers in the participating countries to design and execute the study. The participating countries were Sweden, Denmark, Germany, Great Britain and Spain. Different methods were used in recruiting and interviewing the adolescents (aged 12 to 17 years) and adults (18 to 49 years). Adults were asked to respond to an online questionnaire whereas the adolescents were invited in person to respond to the same questionnaire using computers provided by RTI. Because only data from young adult respondents, 18 to 30 years, were used in the fourth study of this thesis, the procedures of the adolescent part of the study will not be discussed further.

Quota sampling is a type of non-probability sampling method that has sometimes been regarded as an acceptable alternative to probability sampling (Morrow et al., 2007; Im & Chee, 2011). The defining property of quota sampling is that a number of target categories are created, based on the proportion of certain variables in the target population. Potential study participants are then recruited to each target group, and the recruitment process continues until the pre-specified minimum numbers of participants in each of the target categories have been reached (Körner & Wahlgren, 2012). Post-stratification weights are then calculated based on variables with known distributions in the target population. The major benefits of quota sampling relative to stratified probability sampling are that it is quicker and less expensive, and it also does not require a sampling frame. There has been an ongoing debate for years about whether quota sampling is an acceptable alternative to probability sampling. Two recent experimental studies question the validity of quota sampling compared to probability sampling (Guignard, Wilquin, Richard, Beck, 2013; Yang & Banamah, 2014).

The recruitment process was subcontracted to a number of local survey research firms. Many of the firms had participants who had been "pre-screened" for certain characteristics of interest for the survey. Eligible adults from the recruitment databases were sent recruitment letters by e-mail with a link to the online survey and a consent form. To calculate post-stratification weights, the distributions of age, gender, marital status, employment status, education, nativity, alcohol use, and cigarette use for each country were used.

Participants

Study I

A questionnaire, consisting of a range of items reflecting alcohol, tobacco and illicit drug use, as well as demographic variables, was sent by mail to 58,000

individuals selected using the stratified randomized selection process described previously. Eligibility criteria for participation in the study were being 18 to 64 years of age and having a registered address of residence in Sweden. The study participants could respond to the questionnaire by regular mail or via the Internet. Reminders were sent to each individual two and four weeks later and the last reminder included a new copy of the questionnaire.

A total of 22,095 individuals responded to the questionnaire. About one in five (19 percent) of the responses were conducted via the Internet. This gives an overall response rate of 38 percent. When using the sample weights given to each participant, the weighted response rate was 52 percent. A planned analysis of non-responders was conducted by telephone interviews. A random sample of 1000 non-responders was selected and called by interviewers. Up to five attempts were made to contact each individual by phone. Those who responded were asked to complete an abbreviated questionnaire, consisting of 26 of the 58 questions included in the main questionnaire. The weighted response rate was 53 percent, and unweighted data from the main questionnaire were compared to unweighted data from the non-responder questionnaire. No significant differences in the substance use indicators were found between responders and this group of non-responders who did respond in the non-responder analysis.

In the final study sample, using weighted data, 49.2 percent of the respondents were females, 20.8 percent were 15 to 24 years of age, 18.2 percent were 25 to 34 years of age and 61.1 percent were 35 to 64 years of age. This differs markedly from the actual, unweighted frequencies, but closely matches Swedish demographic data from 2008 (Statistics Sweden [SCB], 2015a), indicating that the weighting works as intended with respect to these variables.

Study II and study III

Eleven junior high schools volunteered as intervention schools, and ten schools, selected from the same areas, were selected as control schools. The schools were located in the main metropolitan areas of Sweden (fourteen schools in Stockholm, Gothenburg, and Malmö) or rural areas (seven schools in Gotland, Småland, and Jämtland). The intervention schools were responsible for selecting and implementing interventions from a select list of eligible prevention programs. While they received no monetary compensation for participation in the study, the intervention schools received free education in risk and protection theories, and in-house training in the evidence-based prevention programs that they had selected to work with. Comparison schools continued as usual, without any support, but they were free to use any prevention programs and some of the schools implemented empirically supported interventions during the course of the study.

A total of 2,139 adolescents from 21 schools were eligible for participation in the study, and their parents were asked by mail for consent to let their child participate in the study. Two-thirds of the parents consented (1,436, 67 percent) and their 1,436 adolescent children were asked to in participate in a total of four survey sessions in the classrooms during the course of junior high.

21 schools participated	Autumn, 7th grade	
n = 2,139	Adolescents	1,268 (88%)

Parents' consent	Spring, 7th grade	
n = 1,436 (67%)	Adolescents	1,197 (83%)
	Parents	1,144 (80%)
	Combined	1,018 (71%)

	Spring, 8th grade	
	Adolescents	1,109 (77%)
	Parents	1,085 (76%)
	Combined	916 (64%)

	Spring, 9th grade	
	Adolescents	1,185 (83%)
	Parents	933 (65%)
	Combined	891 (62%)
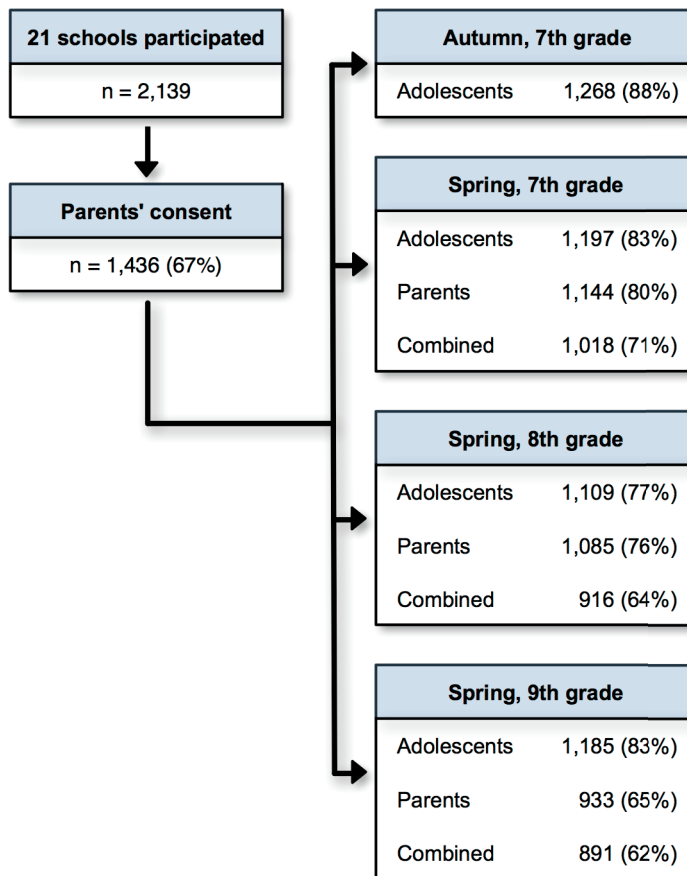
Figure 1. Flow chart of the numbers and percentages of adolescents and parents that participated in each survey session.

The first session was in the autumn semester of the 7th grade, and the following three sessions took place once per spring semester in the 7th, 8th, and 9th grades. The parents were sent a questionnaire to respond by mail in three different waves, corresponding to the spring semester survey sessions that the adolescents participated in during the 7th, 8th, and 9th grades. One parental questionnaire was

sent for each adolescent, to be answered either by father, mother, by both parents together, or by another caretaker. The parents were asked about who had responded to the questionnaire. For this reason, throughout the paper, we will refer to *parents* meaning the respondents to each questionnaire, regardless of who actually did respond to the questionnaire in the individual case. The participation rate was very high, and 1,398 (97 percent) of the adolescents and 1,244 (87 percent) of the parents participated at least once during the course of the study. A flow chart that provides more details about the numbers and proportions of respondents in each wave is provided in figure 1.

For the purposes of study II, the fields that show the combined response proportions of the spring semesters in grades 7 to 9 are the most informative because only those adolescent-parent pairs in which both participated in a particular wave could be included in the study. This is because we wanted to compare the answers between adolescents and parents, so we needed data from both members of each pair. The result is that 62 to 71 percent of parent-adolescent pairs eligible for participation in the study could be included in the analyses. In study III, we used data only from the adolescents and we studied the effect of data recorded at baseline, i.e. the autumn semester of the 7th grade, on the outcome measures of interest at follow-up, the spring semester of the 9th grade. A total of 1,077 adolescents (75 percent) participated in both waves and could be included in our analyses.

Study IV

The total number of respondents in the age group 18 to 30 years was 1,916 individuals. As described above, quota sampling involves creating different target groups based on certain variables of interest, and each target group has a predefined minimum number of participants to be included. The study participants were recruited from the three major metropolitan areas of each country (Stockholm, Gothenburg, and Malmö in Sweden, and Copenhagen, Aarhus, and Odense in Denmark). In Sweden, the minimum numbers were achieved in all groups initially, but in Denmark, additional recruitment in a second phase was needed in order to recruit more males in the age range 18 to 21. This makes response rates somewhat difficult to interpret, but 78 percent of the individuals who were asked to participate in the study accepted which might be considered a high rate of participation. Using weighted data, 51 percent of the participants were women, and 51 percent lived in Sweden vs. 49 percent in Denmark.

Measurements

A variety of measures on substance use were used in the four studies. However, all of the four studies use some measures of alcohol use and one or more measures of illicit drug use. Studies II, III, and IV also include tobacco use as outcome measures. Studies I and IV include similar demographic variables, while studies II and III include variables such as school performance, parental knowledge of adolescent substance use, variables reflecting the parent-child relationship, among others (table 2). The main variables of interest in each study will be outlined under the following headings in this section.

	Study I	Study II	Study III	Study IV
Main outcome variables of interest	Active cannabis use, frequency of cannabis use	Parental awareness of tobacco use, alcohol drunkenness, and illicit drug use	Having been drunk, having been drunk more than 10 times, regular smoking, illicit drug use	Tobacco use, binge drinking, illicit drug use
Main predictor variables	Hazardous alcohol use, illicit drug use other than cannabis, unauthorized prescription drug misuse	Adolescent age and gender, frequency of substance use, school performance	Parenting styles: authoritative, authoritarian, permissive, neglectful	Early onset of alcohol or illicit drug use, and antisocial behavior in adolescence
Other predictor variables	Country of birth, age, gender, family situation, educational attainment, income, occupational status	Baseline substance use	Baseline substance use, gender, parental regular drinking or daily smoking, provision of alcohol by parents, deviant peers, delinquency	Gender, country of residence, country of birth, educational attainment, family situation, occupational status, psychological distress

Table 2. Summary of important outcome and predictor variables in each paper.

Study I

The substance use groups in this study were alcohol, cannabis, other illicit drugs and prescription drug misuse. Hazardous alcohol use was assessed using the Alcohol Use Disorder Identification Test (AUDIT), a validated screening tool for

self-assessment, originally developed to identify individuals with early stages of alcohol problems (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). The instrument consists of 10 items in three domains: consumption, dependence and consequences. The maximum score is 40 points, and a score of 8 points or more for men, and 6 points or more for women, are generally accepted cut-off scores for hazardous and harmful alcohol consumption or possible dependence (Bergman & Kallmen, 2002; Reinert & Allen, 2002; Berner, Kriston, Bentele, & Harter, 2007). These cut-off scores were used in the study to indicate hazardous alcohol use.

Non-medical illicit drug use, including unauthorized prescription drug use (unauthorized use also includes more excessive use than prescribed by a doctor), was assessed with two items for each substance. The substances listed were cannabis (marijuana, hashish, cannabis oil), amphetamine (including methamphetamine and phenmetraline), cocaine (crack, powder, coca leaves), opiates (including heroin, opium and morphine), ecstasy (including MDMA, MDA, MDE), hallucinogens (including LSD, mescaline, peyote, PCP, hallucinogenic mushrooms, DMT), prescription sedatives or sleeping pills (e.g. flunitrazepam, diazepam, zolpidem), and prescription analgesics (e.g. codeine).

In the first item, respondents were asked if they had ever used each substance, and the possible answers were "Never", "More than 12 months ago", "More than 30 days ago" and "less than 30 days ago". In the second item, they were asked about how often they used each substance, and the answering categories were "never", "once per month or less often", "2-4 times per month", "2-3 times per week", and "4 times per week or more".

For the analyses, use of cannabis, prescription drugs (prescription sedatives and analgesics), and other illicit drugs (the rest of the substances from the list above) were regarded as separate variables. Use of each such class of substances were dichotomized in "no use in the past 12 months" and "use in the past 12 months", so that, for example, any use of either amphetamine, cocaine or any of the other illicit drugs (excluding cannabis and prescription drugs) in the past 12 months was considered as other illicit drug use in the past 12 months. For cannabis, another variable based on reported frequency of use was created. Those who reported cannabis use 2-3 times per week or more were compared to the other categories, excluding all respondents who reported no cannabis use in the past 12 months.

The other variables used in study I were gender, place of birth (in Sweden or not in Sweden), age group (we used the age variable to create three age groups: 15 to 24 years, 25 to 34 years and 35 to 64 years), family situation (living with a partner or not), highest level of education (primary school, secondary school or at least two years of university studies), income (below or above median) and occupation (employed, retired, parental or other leave, sick leave, student or internship, unemployed, household labor and other).

Study II

This study used data from both the child and the parent questionnaires. The basic idea was to compare adolescents' report of substance use (smoking, alcohol use and illicit drug use, respectively) to parental reports of their child's use of the same categories of substances, and to identify factors associated with parental awareness. Adolescent substance use was assessed differently across substances. Tobacco use was assessed with an item regarding how often the adolescent smoked cigarettes with the following response categories: "Never tried", "Tried", "Former use", "Sometimes, but not daily" and "Daily". This item was dichotomized into "No use" (including "Never tried" and "Tried") and "Use" (including "Former use", "Sometimes, but not daily", and "Daily"). Adolescent alcohol use was assessed with an item on how many time they had been drunk, with response categories ranging from "Never" to "More than 10 times". Illicit drug use was initially assessed with items regarding whether they had ever used each of twelve substance use categories: cannabis, amphetamine, metabolite (sic!), khat, ecstasy, heroin, crack, LSD, morphine, GHB, other drugs and unknown. Those who reported having ever used any of the substances listed above responded to two items similar to the item on drunkenness, the first regarding how many times they had used cannabis in total, and the other how many times they had used other illicit drugs in total. Any reported use of any illicit drug was considered as use, and reporting use of either cannabis or illicit drugs "5-10 times" or more was used for the frequency of use variable as described below. In the main analyses, drunkenness was dichotomized so that those who had never been drunk were compared to those who had been drunk at least once, and illicit drug use was dichotomized in a similar manner.

The dichotomous variables on adolescent substance use were paired with items on parental report of adolescent substance use. Parents responded to one item on their child's alcohol use ("Has your child ever been drunk?"), one item on cigarette use ("Has your child smoked before, or is currently smoking?"), and one item on illicit drug use ("Has your child tried illicit drugs, i.e. hashish, ecstasy, LSD?). The response categories for these items were "Absolutely not", "Probably not", "Yes, at some occasion", and "Yes, at several occasions". The items were dichotomized so that the two former response categories were compared to the two latter categories.

For each substance group, the responses from each adolescent and their parents can be paired in a 2x2 cross-table as shown in figure 2. There are several different methods of comparing the results from paired data in a situation of comparing agreement between two raters or tests, and each method has a slightly different focus. For example, Cohen's kappa and McNemar's test are two tests for inter-rater agreement. However, these tests are not well suited for use in multivariable models. Aside from statistical tests such as those just discussed, there are four test

33

characteristics that describe the extent of inter-rater agreement, often used in the context of medical tests. These test characteristics do not produce a test statistic but simply a percentage, and these percentages are used for comparison of different medical tests in the detection of a certain condition. All of these diagnostic tests characteristics use one of the raters as the standard and the other one as the test. In the context of the study included in this thesis, adolescent report is used as the standard and parent report is used as the test. A limitation to this approach is the question of the validity of adolescent self-report of substance use. This is discussed elsewhere in this thesis.

Figure 2. 2x2 contingency table of adolescents' vs. parents' report of adolescent substance use. Letters a-d denote cell frequencies.

Sensitivity

Sensitivity in this context is defined as the proportion of true positives (adolescents who report substance use) that are detected by the test (parents who report substance use). This is calculated by $a/(a+c)$ in figure 2 and in this context it is interpreted as the proportion of parents whose child is using substances that are aware of this behavior. In a medical context, it might be defined as the chance that an individual with a disease will be correctly classified by the test.

Specificity

Specificity is similar to sensitivity, but it is defined as the proportion of true negatives (adolescents who report no substance use) that are correctly classified by the test (parents who report no substance use). Using figure 2 as an example, specificity is calculated by $d/(b+d)$. In a medical context this is interpreted as the chance that a patient without a disease will be correctly classified. In the context of this thesis, it is defined as the chance that the parents of adolescents who do not use substances will not report adolescent substance use. Sensitivity and specificity

are probably the most commonly used test characteristics to describe medical tests, and this might be both because they are easily understood and because they are intrinsic to the test and independent on the prevalence of the condition.

Positive and negative predictive values (PPV and NPV)

In a medical context, these test characteristics are defined as the proportion of patients with a positive test score that are true positives for PPV, and the proportion of patients with a negative test score that are true negatives for NPV. In the context of the present paper, PPV would be interpreted as the proportion of parents who reported that their child used substances that were correct, and NPV would be interpreted as the proportion of parents who reported that their child did not use substances who were correct. Unlike sensitivity and specificity, PPV and NPT are dependent on the prevalence of the condition. If a condition is very rare in relation to how many individuals are tested, PPV will be low even though sensitivity and specificity are very high, and the reverse is also true: if a condition is very common in those who are tested but sensitivity and specificity are relatively low, PPV will be high because the condition is so common. Likewise, NPV is conditional on the prevalence among those who are tested, so that if the condition is common, NPV will be low, and if the condition is rare, NPV will be high, regardless of whether sensitivity and specificity are high or low. The results of PPV and NPV are thus conditional on the prevalence of the condition among those who are tested, making the results more difficult to interpret.

When planning the analyses for study II, all of the alternatives described above were considered. The main aim of the study was to assess what parents really know regarding their children's substance use behavior, and secondary aims were to identify factors associated with parental awareness. All of the methods described above might be considered to say something about what parents know, but while McNemar's test and Cohen's kappa cannot easily be used as the dependent variable in a multivariable analysis, the diagnostic test characteristics lend themselves well to such analyses. Furthermore, we reasoned that from an intervention perspective, the most important issue is to detect adolescents who use substances, as we believe that a parent's knowledge about their child's substance use may be important so that the parent may take measures to make the child reduce their substance use. We thus considered sensitivity to be the most important measure as it reports the proportion of parents whose children use substances that are aware of this behavior. For each substance group (alcohol, cigarettes, and illicit drugs) and for each grade (7th, 8th, and 9th) a binary variable was thus created, using only those cases in which the adolescent reported substance use, and comparing cases in which parents reported use and no use. These variables, reflecting sensitivity of parental report for detecting adolescent substance use, will be referred to as parental knowledge throughout this thesis.

We therefore chose to include only those adolescents who reported having used each substance, and used parental awareness of adolescent substance use as the outcome measures. For each substance group (alcohol, cigarettes, and illicit drugs) and for each grade (7th, 8th, and 9th) a binary variable was thus created, using only those cases in which the adolescent reported substance use, and comparing cases in which parents reported use and no use. These variables, reflecting sensitivity of parental report for detecting adolescent substance use, will be referred to as parental knowledge throughout this thesis.

As stated above, data from the spring semesters in grade 7, 8 and 9 were used. Due to the repeated measures design, there is inevitably a correlational structure in the data, in that data from an individual in grade 7 will be correlated to data from the same individual in the later grades. School grade could thus not be used as a regular variable in the analyses, and we chose to stratify most of the analyses by school grade.

The other variables used in the study were adolescent gender, group (referring to the quasi-experimental design so that individuals in intervention schools were compared to individuals from control schools), school performance and substance use frequency. School performance data were available only for the 8th and 9th grades because no grades were given in the 7th grade in Sweden at the time of the study. A composite score of the grades in three core subjects (Swedish, English and Mathematics), each scored from 1 (failed) to 4 (passed with special distinction), was used to calculate quartile groups. The highest quartile group was used as the reference throughout the analyses. Substance use frequency was a dichotomous variable per substance: for alcohol drunkenness and illicit drug use, 1-4 times were compared to 5 times or more, and for cigarettes, "Tried" served as the reference category and "Sometimes" and "Daily" were compared to the reference.

Study III

In this study, the primary aim was to study the influence of parenting styles on adolescent substance use. The outcome measures at follow-up used were lifetime alcohol drunkenness, having been drunk ten times or more, regular smoking, and illicit drug use. There is an obvious risk for reverse causality in this line of research, i.e. substance use in adolescence might influence the parenting style. In order to address this issue in the best way possible, we chose to use data from the autumn semester in the 7th grade as the baseline, and use data from the spring semester in the 9th grade as the follow-up data. Furthermore, in the analyses of lifetime drunkenness and lifetime illicit drug use at follow-up, those who reported any baseline use of each substance, respectively, were excluded from the analyses. Two of the analyses thus modeled the odds of starting to drink alcohol to

drunkenness or use illicit drugs in substance-naive individuals during the course of junior high school, using baseline data as predictors and with a follow-up time of over 2.5 years. The other two analyses modeled the odds of having been drunk ten times or reporting regular smoking at follow-up.

Lifetime alcohol drunkenness was assessed with an item on how many times the adolescents had drunk alcohol to the point of feeling drunk. Any answer that indicated that the adolescent had been drunk was considered positive, and a binary variable was thus constructed comparing those who had ever been drunk to those who had not. Having been drunk ten times or more was assessed using the same item as lifetime drunkenness, but for this outcome measure, having been drunk ten times or more was compared to having been drunk less than ten times or not at all. Regular smoking was also assessed with the same item as in study II, and those who reported "Never tried", "Tried" and "Former use" were considered not being regular smokers, and were compared to those who reported "Sometimes" and "Daily", who were considered being regular smokers. Lifetime illicit drug use was assessed in a similar manner, and as described previously, the adolescents answered items on lifetime use separately for each of twelve drug classes and then items on how many times they had used cannabis and other illicit drugs, respectively. Four binary variables on substance use were thus created for the 9th grade: alcohol drunkenness, having been drunk more than ten times, regular smoking and illicit drug use, and these variables were used as the main outcome measures in this study.

The main predictor variable of interest was parenting style. Parenting styles can be conceptualized in a number of ways, as discussed in the introduction section. One of the most commonly used conceptualizations in the context of adolescent substance use is the four-fold typology by Maccoby and Martin (1983) that is based on the earlier work of Baumrind (Baumrind, 1967; Maccoby & Martin, 1983). This operationalization was one of the first used in the context of adolescent substance use, and it has been used in several studies on this topic (e.g. Lamborn et al., 1991; Shakya et al., 2012; Stafström, 2014). The operationalization that we try to mimic is based on two dimensions of parenting: responsiveness and demandingness as described in the introduction section. To assess these dimensions, we used data from the adolescents' questionnaire from the 7th grade, in which there were 28 Likert-type items on perceived parenting and other aspects of the parent-child relationship. Keeping the operationalization in other studies in mind, we manually selected 13 items that we considered best mirrored the items used in previous studies. We then conducted principal component analysis on these items, which resulted in two distinct factors that corresponded to the two dimensions that we set out to assess. The 13 items and their factor loadings can be found in table 3 below.

Items on parenting style	Demandingness	Responsiveness
Do your parents know what you do in your spare time?	0.59	
If you go out a Saturday night, do you have to tell your parents where you're going and who you're going to see?	0.81	
Do your parents ask for your opinion when they are going to decide in a family matter?		0.63
Do your parents know what you're doing in the afternoons after school?	0.64	
Do your parents let you take part in important family decisions?		0.72
Do you have to have your parents' permission to stay out late at weekday nights?	0.76	
If you have another opinion in a matter, do your parents take this into account and change their decision?		0.66
Does it feel like your parents have faith in you and let you take responsibility for your life?		0.73
Do you have influence and feel involved in matters within the family?		0.65
If you come home late at night, do your parents demand that you tell them what you've been doing and who you have seen?	0.74	
Do you get to finish talking when arguing at home?		0.65
When you've been out at night, do you tell your parents what you've been doing?	0.64	
Do your parents know where you are when you're out with friends in the evening?	0.68	

Table 3. The items on parenting styles asked to adolescents in the 7th grade. Factor loadings on the aspects demandingness and responsiveness in the middle and right columns. Factor loadings below 0.3 not shown in the table.

Using the two dimensions of parenting identified in the principal component analysis, we summed the scores of all items for each dimension so that two composite scores for responsiveness and demandingness, respectively, were created for each adolescent. We then dichotomized each score into high and low

using the median as cut-point, and using the two binary variables thus created, we could then construct the four typologies based on the four possible combinations.

Aside from the substance use outcome variables and the parenting style variables described above, we included a number of variables assessed at baseline. Lifetime alcohol drunkenness, cigarette use, and illicit drug use, as well as regular smoking at baseline, were used when appropriate as described above. Parental regular drinking and daily smoking were assessed with the items "Who among your friends or family drink alcohol regularly (at least once per week)?" and "Who among your closest family and friends smoke daily or regularly?" and if the adolescent reported that at least one of their parents engaged in each behavior, they were coded as parental regular drinking or daily smoking, respectively. Adolescents also responded to an item on if their parents serve alcohol to them at home, and any report of this having occurred was considered as positive report of parental serving of alcohol.

Some items thought to reflect the adolescents' social situation in school and among friends were also included. An item on how individuals like it at school was also used by dichotomizing the response to the item "How do you like it at school?" so that "very badly", "rather badly", and "neither well nor bad" were compared to "rather well" and "very well". In the variable selection process described in the data analysis section, we compared using the full item as a continuous variable to using it as a dichotomized variable.

Association with deviant peers was measured with eight items regarding deviant behavior in the responder's peers. The items regarded how many of the peers reported a range of deviant behaviors, including substance use, and the response categories ranged from "none", to "most". Principal component analysis identified one factor to which all the items loaded, and an index was thus created ($\alpha = 0.83$). This index was then dichotomized so that those individuals with scores in the upper quartile, indicating the most deviant peers, were compared to those scoring in the three lower quartiles. In the variable selection process described below, we compared using the full item as continuous data to using the dichotomized item.

Adolescent delinquency was assessed using a similar approach, with a scale of 18 binary items ($\alpha = 0.84$) that reflected a range of delinquent behaviors such as petty and major crimes of sexual, violent or drug-related character. Since two thirds reported no delinquent behavior, and the majority of those who reported delinquent behavior reported very few such behaviors, we decided to dichotomize the variable so that those who reported no delinquent behaviors were compared to those who reported at least one such behavior. In the variable selection process described later, we compared using the dichotomized variable to using the full scale as a continuous variable.

Study IV

The primary outcome measures in study IV were current tobacco use, binge drinking and illicit drug use. Tobacco use was assessed with two items: the participants first responded to an item on lifetime use of cigarettes, and those who reported use then responded to an item on how often they currently used cigarettes or snus, which is a form of moist tobacco for oral use, commonly used in Sweden. The response categories were: "not at all", "sometimes" and "every day". Any reported current use (i.e. the latter two categories) was considered as current use.

Binge drinking was assessed with a sequential range of items. Firstly, the study participants responded to an item on lifetime alcohol use. Those who responded positively were asked to respond to an item on whether they had ever drunk 12 glasses of alcohol during any one-year period. Those who reported having done this were then asked to report the maximum number of glasses of alcoholic beverage consumed during one day in the past year, and the response categories were "None", "1-4 glasses", "5-11 glasses", "12-19 glasses" and "20 glasses or more". Those responded differently than "None" were then asked how many days in the past year they had drunk the amount of glasses specified in each category, up to the highest category reported. For example, if an individual reported having drunk a maximum of 5-11 glasses during one day in the past year, that individual then got to report how many times he or she had drunk 1-4 glasses and how many times he or she had drunk 5-11 glasses, but he or she was not asked about drinking 12-19 glasses or 20 or more glasses. As we were primarily interested in risk drinking, we chose to sum the number of days each respondent reported having drunk 5 glasses or more. We then constructed a binary variable on binge drinking, so that those who had drunk 5 glasses or more on at least 12 occasions in the past year were compared to the all the others. Since a substantial proportion of the individuals who reported having drunk alcohol did not report having ever drunk 12 glasses in any one-year period, we suspected that this item might have been misunderstood. It seems unlikely that a large percentage of lifetime drinkers have not ever had 12 glasses of alcohol during the course of an entire year, and we thought a plausible explanation might be that some of the study participants misunderstood the question and thought that it referred to having ever had 12 glasses of alcohol in one day. We therefore constructed another variable on binge drinking, which included only the subset of individuals who reported having ever drunk 12 glasses of alcohol during any one-year period. This did not significantly alter the results from the alcohol analyses as will be seen in results section.

Illicit drug use was assessed with two sets of items for each of 5 classes of substances: cannabis, cocaine, heroin, amphetamines and designer drugs ("...can include bath salts, ecstasy, Spice, ketamine, mephedrone and 'legal highs'"). The study participants first responded to an item on lifetime use of each of the substance categories, and then responded to an item on time since the last use of

each substance that they had used. Current illicit drug use was defined as reported use in the past 30 days of any of these substance categories.

All study participants who reported any lifetime use of alcohol or illicit drugs were asked to report how old they were when they first used alcohol or illicit drugs, respectively. For both alcohol and illicit drugs, we considered onset of substance use in the lower quartiles of reported ages of onset as early onset. The variables early onset of alcohol use (age of onset at 13 years or less) and early onset of illicit drug use (age of onset at 15 years or less) were thus created.

Early antisocial behavior was assessed using a scale implemented from the WHO Composite International Diagnostic Interview (CIDI), which is a comprehensive, fully structured interview designed to assess mental disorders based on diagnostic criteria from ICD-10 and DSM-IV. CIDI was developed with the intention to aid in epidemiological surveys in many countries, and the different iterations of the instrument have been used in numerous surveys (Kessler & Ustun, 2004). The survey that is the basis of study IV of this thesis included some of the screening instruments that have been validated for self-administration (Haro et al., 2006). One of these instruments that tests for conduct disorder (CD) was included in an abbreviated form, asking about a range of deviant behaviors (e.g. truancy, stealing, tell a lot of lies, hurting animals) before 15 years of age. The instrument contained 7 of the 11 items used in the CIDI instrument. Each item could be answered by yes or no. As the instrument was modified from the original, we took the liberty to score it by summing the positive responses and comparing the highest scoring quartile - with a positive response on two items or more - to the rest. We refrained from using the term conduct disorder as this might indicate that the instrument in this form has been validated, and instead chose to use the term early antisocial behavior.

We used the Kessler Scale-6 (K6) to assess psychological distress. The K6 is a six-item screening instrument for anxiety and mood disorders as defined by DSM-IV diagnostic criteria. The six items regarded how often the respondents had experienced different symptoms during the past six months: nervousness, hopelessness, restlessness, depressed mood, worthlessness and feelings that everything was an effort. The answering categories ranged from "Not at all" to "All the time" and the maximum score was 24 points. The K6 has been extensively tested and studies have shown that a score of 13 or more indicates a high risk of meeting DSM IV diagnostic criteria for a mood or anxiety disorder (Furukawa, Kessler, Slade, & Andrews, 2003; Kessler et al., 2003). We created a binary variable, psychological distress, so that those who scored at least 13 were compared to those who scored 12 points or below.

Aside from the variables outlined above, we also included several demographic items that have been found to be associated with substance use in young adulthood (Hu, Davies, & Kandel, 2006; Lawrence, Fagan, Backinger, Gibson, & Hartman,

2007; Kestila et al., 2008; Patrick, Wightman, Schoeni, & Schulenberg, 2012; Redonnet, Chollet, Fombonne, Bowes, & Melchior, 2012). The variables thus included were: Gender, country of residence (Denmark or Sweden), country of birth (same country as the country of residence or not), educational level (having any tertiary education or not), housing status (living alone or cohabiting), and employment status (paid work, studies, military service and community service were compared to being unemployed, retired, disabled or doing unpaid work at home).

Data analysis

As summarized in table 1 (p. 25), the main statistical method used for multivariable analysis in three of the four studies included in this thesis is logistic regression, and in the fourth study, we used a model closely related to logistic regression. Logistic regression is a special case of the generalized linear model (GLM). All GLM's have one dependent (outcome) variable and can have many independent variables (predictors). Multiple regression is also a special case of GLM and while in multiple regression, the dependent variable is continuous and assumed to be normally distributed conditional on the independent variables, in logistic regression the dependent variable is binary. This method is popular because it enables multivariable study with binary outcomes that are frequently used in many branches of science, and it is also quite straightforward to use because it relaxes some of the assumptions made with multiple regression models.

The basic logistic regression model can be altered in various ways. In logistic regression, a binomial distribution of the dependent variable is assumed. One alteration of logistic regression is to estimate the parameters with a quasi-likelihood estimator instead of the usual maximum likelihood estimator. The resulting model is then called quasi-binomial regression. This makes it possible to use post-stratification weights, and this method was used in the fourth paper. Another alteration is to allow for non-linear relationships between independent variables and the dependent variables by using regression splines, and this method was used in the third paper. This requires that a generalized additive model (GAM) with the same distributional assumptions and link function. A more in-depth description of the logistic regression model and these alterations can be found in statistical textbooks (Gelman, 2007; Zuur, Ieno, Walker, Saveliev, & Smith, 2009).

Study I

In this study, three logistic regression models were conducted on unweighted data. In the first model, we modeled active cannabis use, defined as any use in the past 12 months, as a function of gender, place of birth, age group, family situation, education, income, and occupation. In the second model, hazardous drinking, other illicit drug use, and prescription drug use were added as predictor variables. In the third model, we conducted a subgroup analysis on those who reported any active cannabis use in the past 12 months, and we studied the effect of the same predictor variables on frequency of cannabis use, defined as 2-3 times per week or more compared to 2-4 times per month or less. All analyses were conducted in SPSS 18 (SPSS Inc., 2009).

Study II

Parental awareness of adolescent cigarette use, alcohol drunkenness, and illicit drug use was assessed in this study. We first studied the association of parental awareness, operationalized as sensitivity (i.e. parents who knew about their child's substance use were compared to those who did not knew, and all adolescents who didn't use substances were excluded from the analyses) and several predictor variables in bivariate analyses: sex, grade, intervention or control school, lifetime drunkenness, lifetime cigarette use, lifetime illicit drug use, and school performance for the 8th and 9th grades. These variables were chosen because we thought that they were the ones that were most important for parental knowledge of their children's substance use. We then conducted a series of logistic regression analyses separated by substance type and school grade, and we included in the regression models those variables that were significant at the 0.05 level in the bivariate analyses. For cigarette use, we conducted three regression models for the 7th, 8th, and 9th grades, respectively. In the analyses using parental awareness of alcohol drunkenness as the dependent variable, we had to omit the analysis for the 7th grade because the small number of parents that were aware (n = 10) did not permit the inclusion of more than one independent variable in the analysis in order to avoid overfitting. The same problem pertained to the analyses of parental awareness of illicit drug use, where the numbers of aware parents were small for all grades (1, 3, and 2 for the 7th, 8th, and 9th grades, respectively), and no logistic regression models were conducted for illicit drug use. All analyses were conducted using SPSS 20 (IBM Corp., 2011).

Study III

In this study, we wanted to model four different outcomes using logistic regression models. The outcome measures in the four models, measured at follow-up 2.5 years after baseline data were gathered, were: lifetime alcohol drunkenness, drunkenness more than 10 times, regular smoking, and lifetime illicit drug use. The main predictor variable of interest was parenting style, coded as dummy variables where authoritarian, permissive, and neglectful parenting styles were compared to authoritative parenting style, which served as the reference category. The other predictor variables of interest were sex, parental regular smoking or drinking, provision of alcohol by parents, whether the adolescent liked it at school or not, deviant peers, delinquency, and baseline substance use. We also wanted to control for the experimental group status of the school that each adolescent belonged to. The predictor variables deviant peers, delinquency, and like it at school could be included in the analysis in different ways: either as continuous variables or as dichotomous variables, as described above.

In the first stage of analysis, we conducted a variable selection process by comparing the performance of the different variants of the predictor variables deviant peers, delinquency, and like it at school on the Akaike information criterion measure (AIC). The dichotomous items for delinquency and like it at school were preferred for all outcome measures, and the continuous deviant peers variable was preferred for all outcome measures. For three of the outcome measures, a linear relationship with deviant peers provided the best fit, and for the fourth outcome, illicit drug use, a non-linear relationship in the form of a regression spline model, provided the best fit. This means that while standard logistic regression models could be used for the first three outcome measures, a generalized additive model had to be used for the illicit drug use model.

We then conducted a stepwise model selection process to help us decide what variables should be included in the analyses. In short, this process starts with all predictor variables and relevant interactions included in the model. The variables are then dropped from the models one by one using ANOVA, in each step identifying the variable that contributes the least to the model. For each step, the new model (with a dropped variable) is compared to the previous model using a likelihood-ratio test. When the model cannot be improved by dropping variables, each dropped variable is then added to the model again, and likelihood-ratio tests are used to determine whether each variable should be added to the model. In cases where likelihood-ratio test cannot be used (such as when comparing generalized additive models), AIC is used to manually determine which model to select (Zuur et al., 2009; Collett, 2014). Data preparation and principal component analysis were conducted using SPSS 22 (IBM Corp., 2013). The rest of the data analysis work was conducted using R 3.1.3 (R Core Team, 2015).

Study IV

A series of generalized linear regression models using weighted data were used in this study. As described previously, quasi-binomial regression models were used instead of logistic regression models in order to take the post-stratification weights into account while delivering an output that is interpreted in the same way as the output from a logistic regression model.

The outcome measures were cigarette use, binge drinking and illicit drug use. The predictor variables of potential interest were: Age, gender, country of residence, foreign born, antisocial behavior at age 15, alcohol use at age 13, illicit drug use at age 15, having no tertiary education, living alone, being unemployed, smoking, binge drinking, using illicit drugs and reporting psychological distress. Since post-stratification were used, standard methods for model selection based on likelihood ratio tests or the Akaike information criterion (AIC) (Zuur et al., 2009) were not available, and we therefore included all the predictor variables of interest in the analyses. The exceptions to this rule were the interaction terms between country of residence and the other predictor variables. Only those interaction terms that showed a statistically significant effect on the outcome variables were included in the final models. This resulted in only one interaction term being included in one of the models. The interaction between country of residence and illicit drug use at age 15 had a significant effect on illicit drug use in young adulthood. We thus created four models: one model for current tobacco use, two models for binge drinking, and one model for illicit drug use, as explained previously. SPSS 22 was used for data management purposes and bivariate analyses (IBM Corp. 2013). R 3.1.3 was used for the regression modeling with the survey package to account for the post-stratification weights (Lumley, 2004; Lumley, 2014; R Core Team 2015).

Ethics

Study I

The Regional Ethics Committee of Umeå, Sweden, ethically approved the project.

Study II and III

The Swedish National Board of Health and Welfare approved the project ethically in 2003-12-08 (File Number: 68-392/2000).

Study IV

The Institutional Review Board at RTI International initially approved all methods and procedures. The Regional Ethics Committee of Lund, Sweden, ethically approved the Swedish part of the project. In Denmark, the regional ethics board of the Capital Region (Copenhagen) decided that Danish legislation does not require an ethics approval for the present study.

Results

Study I

Using weighted data, 49 percent of the respondents were female, 16 percent were not born in Sweden, and 21 percent belonged to the age category 15 to 24 years of age, 18 percent to the category 25 to 34 years of age, and 61 percent belonged to the category 35 to 64 years of age. As can be seen in figure 3, hazardous drinking is by far the most prevalent of the substance use behaviors presented, reported by 23 percent of the men and 21 percent of the women. Overall, men are slightly overrepresented across all substances, and though it cannot be clearly seen in figure 3, 1.4 percent of men and 1.1 percent of women report illicit drug use, which is a difference of 27 percent (p = 0.02).
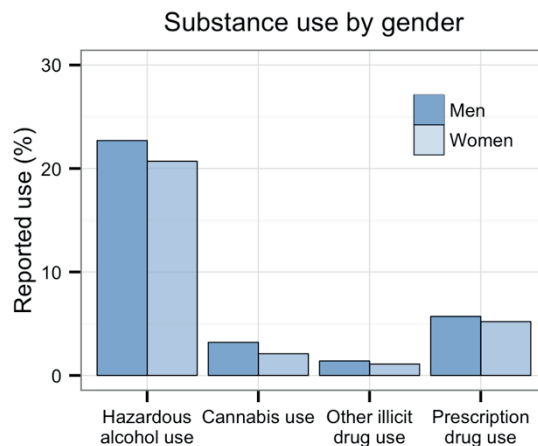

Figure 3. Study I: Substance use by gender. All gender differences are significant at the 0.05 level.

The levels of substance use vary across different ages. In figure 4, the different categories of substance use are plotted against age. Hazardous drinking, as well as cannabis use and other illicit drug use, is clearly more common among young adults, and they all show a marked decline starting in the late twenties. However, while cannabis use and other illicit drug use diminishes in the higher age groups,

hazardous drinking remains prevalent, and 15 percent of the individuals aged 40 years or older reported hazardous drinking. Unauthorized use of prescription drugs follows a different pattern, and while reported use of these types of drugs is slightly more common among the younger and older age categories, the prevalence seems quite stable across ages with a mean prevalence of 5.6 percent across all ages.
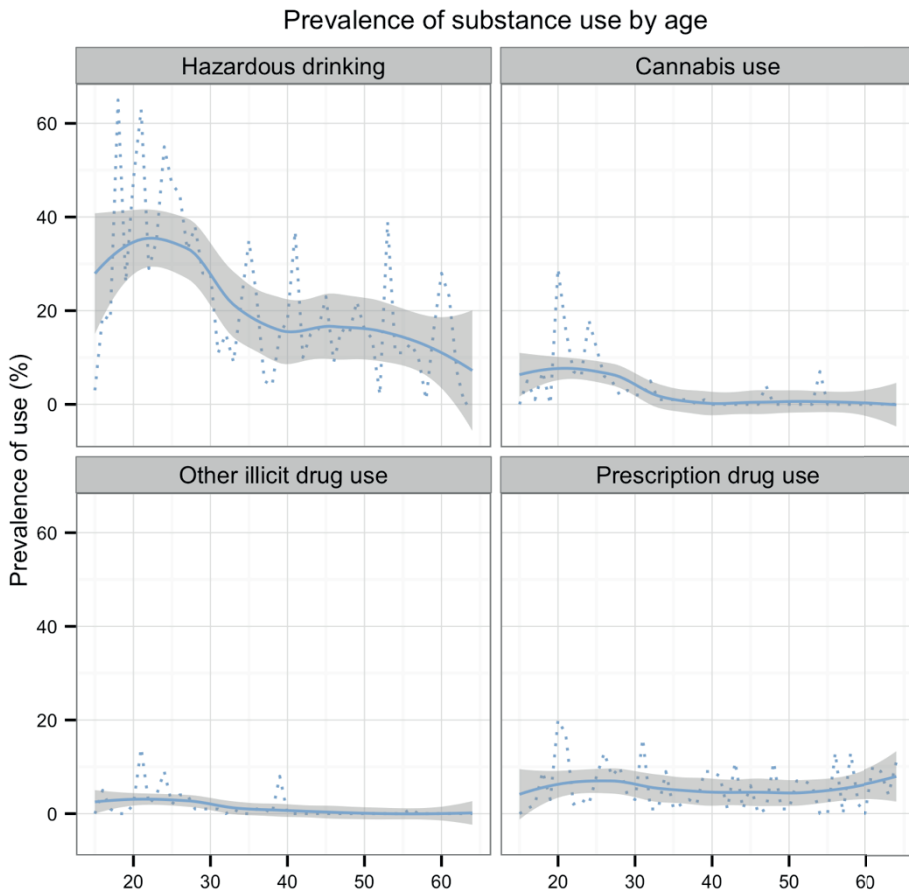

Figure 4. Study I: Reported substance use by age. Dotted lines indicate reported frequencies. Solid lines are LOESS smoothers, used to aid in visual interpretation. Grey areas indicate 95% confidence intervals. LOESS is an acronym for local regression, which is a procedure for fitting smooth curves to scatterplots. This is often used to enhance visualization of non-linear relationships in the data (Zuur et al., 2009).

Figure 5 shows adjusted odds ratios from the logistic regression model with active cannabis use as the dependent variable. Active cannabis use was associated with

hazardous drinking, other illicit drug and prescription drug use compared to non-users. We also found that women were less likely to use cannabis than men, and that individuals aged 35 years or more were less likely to use cannabis when compared to the youngest age group, 15 to 24 years.
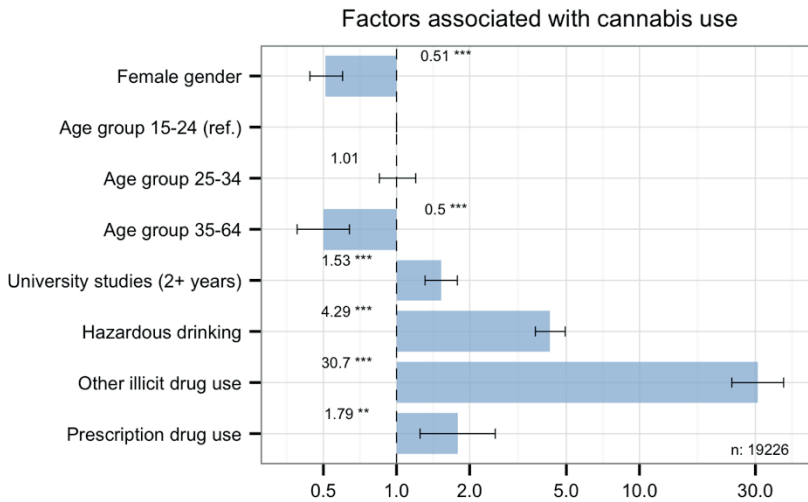

Figure 5. Study I: Factors associated with active cannabis use. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001. Not all factors are shown, please see table 3 in study I.

In the subgroup analysis of participants who reported cannabis use in the past year, frequent cannabis users (2-3 times per week or more) were compared to occasional users (2-4 times per month or less), and the results are summarized in figure 6. Individuals aged 35 years or more were more likely to report frequent cannabis use. Other illicit drug use was also associated with frequent cannabis use. Frequent cannabis use was significantly negatively associated with hazardous drinking.
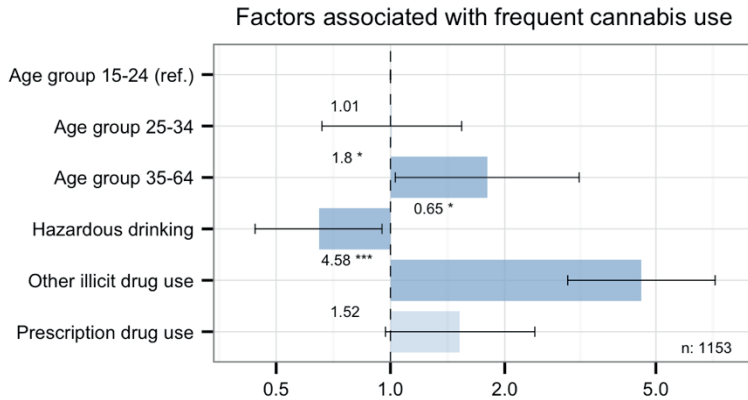
Figure 6. Study I: Factors associated with frequent cannabis used, compared to occasional use. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001. Not all factors are shown, please see table 4 in study I.
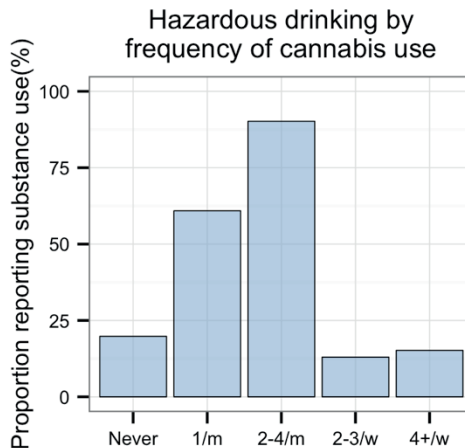

Figure 7. Study I: Hazardous drinking by frequency of cannabis use per month (m) or week (w).

This seemingly non-linear relationship between frequency of cannabis use and hazardous drinking is explored further in figure 7, in which the prevalence of hazardous drinking is shown for each level of cannabis consumption. This diagram clearly illustrates the results from the subgroup analysis described above. There seems to be an obvious association between occasional cannabis use and hazardous drinking, but those individuals who report more frequent cannabis use

50

tend to report hazardous alcohol use less frequently, and perhaps even less frequently than those who do not use cannabis.

Study II

In the panel data that is the basis of studies II and III, adolescents were followed from the 7th to the 9th grade and were repeatedly asked about substance use habits. The percentages of adolescents that report ever having smoked cigarettes, been drunk, and used illicit drugs, respectively, are summarized in figure 8. The prevalence of reported use increases over time during the course of junior high school, and this association was statistically significant for all categories of substances.
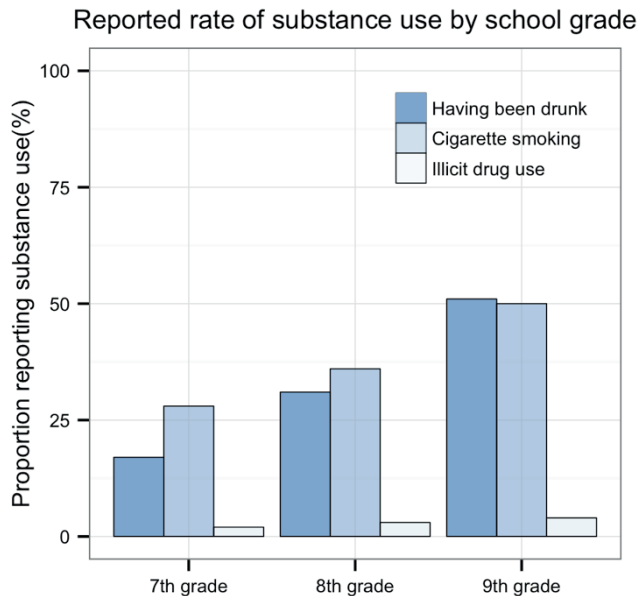

Figure 8. Study II: Reported rates of lifetime substance use by school grade.

Parental awareness of adolescent substance use, i.e. the proportion of parents who knew about their child's substance use, was generally very low across substances and grades. Figure 9 shows the percentages of parents that were aware of their child's substance use across the different substance use categories and school grades. Only six percent of the parents whose child had been drunk in the 7th

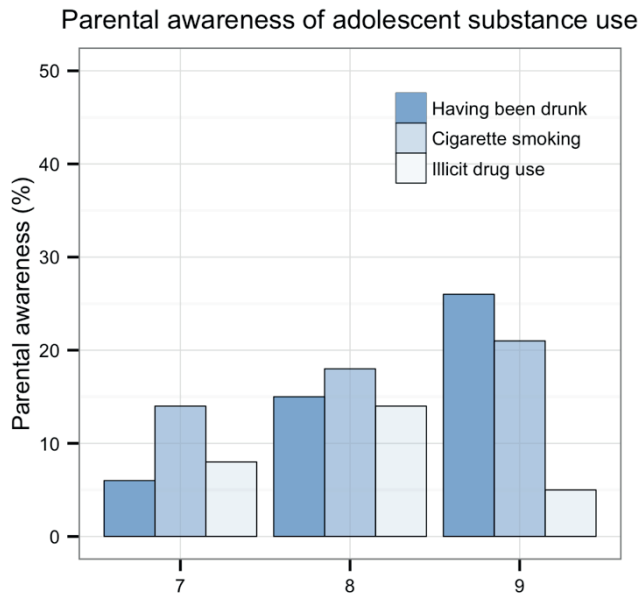grade were aware of this, though this increased to 26.1 percent in the 9th grade (p < 0.001)

Figure 9. Study II: Parental awareness of adolescent substance use by substance use category and school grade.

Parental awareness of cigarette use also increased over time, and though the change over time was smaller than for parental awareness of adolescent alcohol use, it was still statistically significant (p = 0.04). The rate of parental awareness of adolescent cigarette use in the 9th grade was 21 percent. The rates of parental awareness of adolescent illicit drug use were also low, but based on extremely few cases (one parent aware in the 7th grade, three in the 8th grade, and two in the 9th grade). No linear trend could be identified.

We also studied the associations between parental awareness of adolescent alcohol and cigarette use, and a number of variables, first in bivariate analyses and then in logistic regression models. The numbers of parents that were aware of their children's illicit drug use were so low in all grades that no significant associations could be detected even in the bivariate analyses. Therefore, no multivariate analyses were conducted on parental awareness of adolescent illicit drug use. Logistic regression models were conducted for the 8th and 9th grades for alcohol, but not for the 7th grade because very few parents were aware of their children's alcohol use. A multivariate analysis was thus not appropriate due to the risk of overfitting. Regression models were conducted for parental awareness of cigarette

use for all grades, but for illicit drug use, parental awareness was too low in all grades for multivariate analysis.
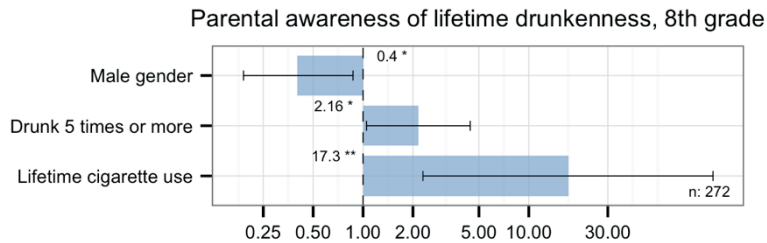
Parental awareness of lifetime drunkenness, 8th grade

Figure 10. Study II: Factors associated with parental awareness of adolescent alcohol use in the 8th grade. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

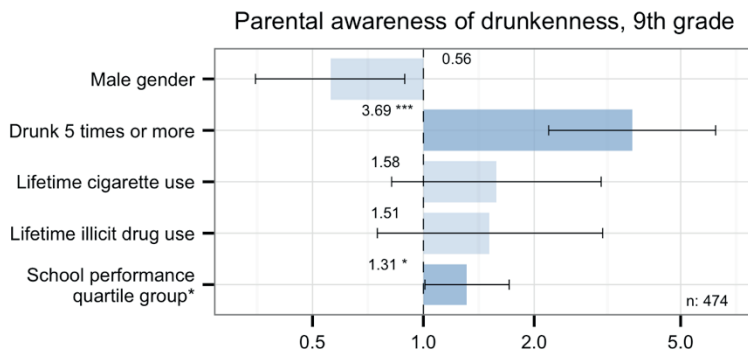**Parental awareness of drunkenness, 9th grade**

Figure 11. Study II: Factors associated with parental awareness of adolescent alcohol use in the 9th grade. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

Figures 10 and 11 show the results from the regression models of parental awareness of alcohol use in the 8th and 9th grades, respectively. As can be seen, in the 8th grade, parents to boys were significantly less likely to be aware that their child had been drunk, and parents whose child had used cigarettes were also more likely to be aware that their child had been drunk. Having been drunk 5 times or more, compared to having been drunk 1-4 times, was associated with higher rates of parental awareness in both the 8th and the 9th grades. The school performance quartile group that is shown in figure 11 is a linear predictor with four levels, the highest level (i.e. the best academic performance in school) serving as the reference. A negative linear relationship was found between school performance

and parental awareness of alcohol drunkenness in the 9th grade, so that parents of children who performed worse in school were more likely to be aware of their children's alcohol use after adjusting for the other variables.

Figure 12. Study II. Factors associated with parental awareness of adolescent cigarette use in the 7th grade. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

Figure 13. Study II: Factors associated with parental awareness of adolescent cigarette use in the 8th grade. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.
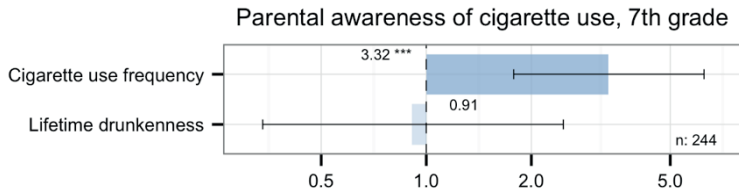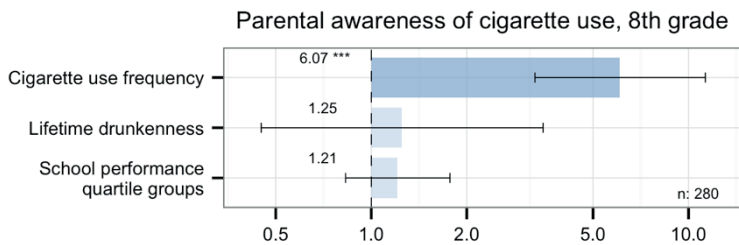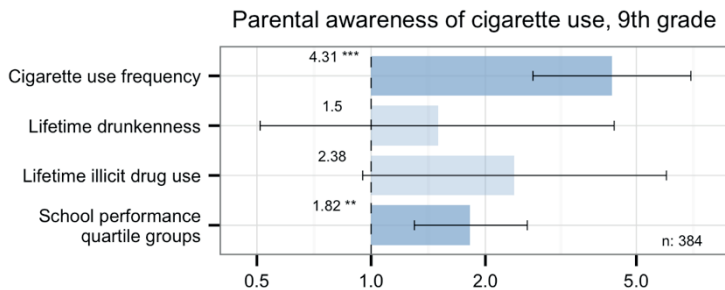
Figure 14. Study II: Factors associated with parental awareness of adolescent cigarette use in the 9th grade. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

Figures 12-14 show the results from the regression models that use parental awareness of adolescent cigarette use as the dependent variable. Cigarette use frequency was highly associated with parental awareness in all grades. As described earlier, the categories were *tried*, *sometimes*, and *daily*, and the odds ratios given in figures 12-14 denote the change in odds when comparing tried to sometimes, or comparing sometimes to daily. These results indicate a strong positive association between parental awareness and frequency of cigarette use. There was also a negative association between school performance and parental awareness of their child using cigarettes in the 9th grade, similar to what was seen with alcohol use above, while this could not be seen in the 8th grade. This means that among adolescents who reported smoking, those who had lower grades were more likely to have parents that knew about their smoking than those who had higher grades.

Study III

The aim of this study was to study the importance of parenting style on the onset of substance use during the course of junior high school. As described earlier, we used data from the autumn semester in the 7th grade and the spring semester in the 9th grade, for the third study. The follow-up time was approximately 2.5 years. When studying onset of drunkenness during junior high school as the outcome, we excluded those adolescents who reported having used alcohol at baseline. Likewise, we excluded those who had used illicit drugs at baseline when studying onset of illicit drug use during junior high school as the outcome. At baseline, eleven percent had been drunk, 25 percent had ever used cigarettes but only three percent were regular smokers, and 0.8 percent had used illicit drugs. At follow-up, 51 percent had been drunk, 18 percent had been drunk ten times or more, 18 percent were regular smokers, and five percent had used illicit drugs.

Adolescents who perceived their parents as permissive or neglectful in the 7th grade were more likely to have been drunk at follow-up, in the 9th grade. As can be seen in figure 15, these associations did not remain statistically significant when adjusting for the other predictor variables in the regression model. Female gender, provision of alcohol by parents, delinquency and baseline cigarette use were all significantly associated with having been drunk at follow-up.

Figure 15. Study III: Factors associated with having been drunk at follow-up. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

In the next set of bivariate analyses, those who perceived their parents as permissive or neglectful were more likely to have been drunk more than ten times at follow-up, while those who perceived their parents as authoritarian were less likely to have been drunk more than ten times. The adjusted odds ratios from the multivariate regression model are shown in figure 16, and it can clearly be seen that authoritarian parenting style, compared to authoritative parenting style, remained associated with not having been drunk more than ten times at follow-up. Female gender, delinquency, having been drunk or smoked cigarettes at baseline were all significantly associated with having been drunk ten times or more at follow-up.
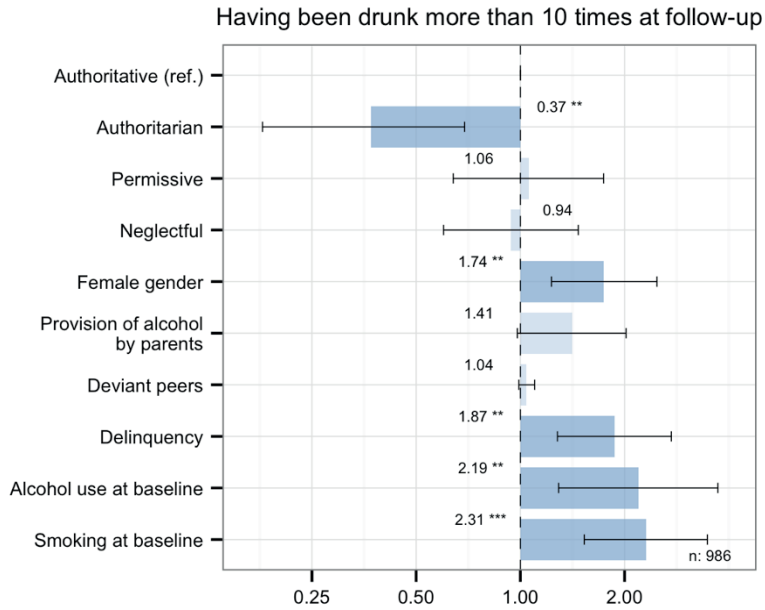
Figure 16. Study III: Factors associated with having been drunk more than ten times at follow-up. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

Regular smoking at follow-up was more common among adolescents who perceived their parents as neglectful in the 7th grade, compared to those who perceived their parents as authoritative. However, in the regression model, shown in figure 17, parenting style did not remain significantly associated with regular smoking. The only parental factor that remained significant in the regression model was provision of alcohol by parents. Female gender, delinquency, having deviant peers, having been drunk, and having smoked cigarettes at baseline were all significantly associated with regular smoking at follow-up.
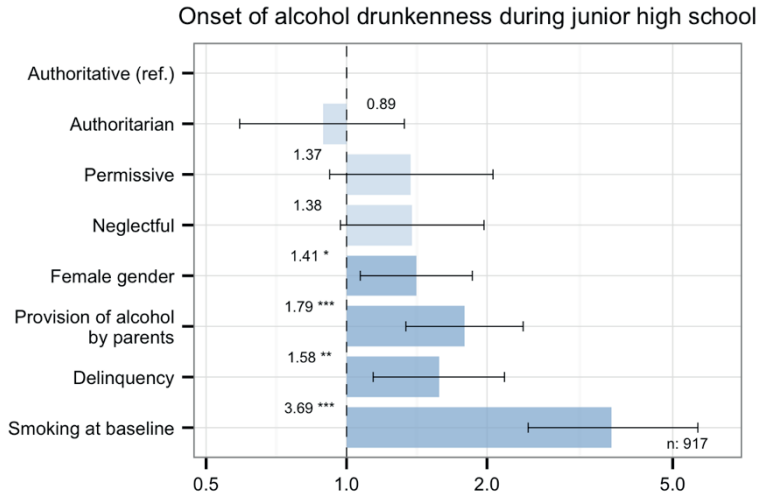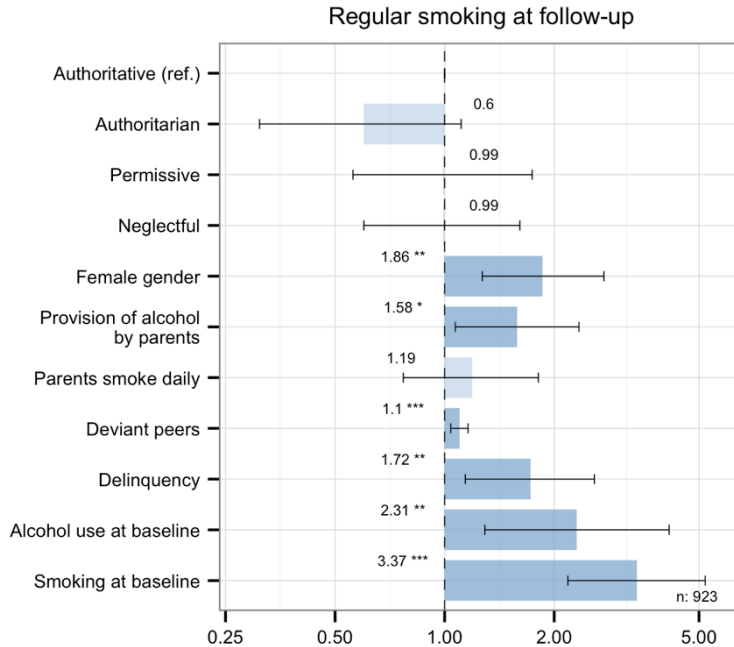
Figure 17. Factors associated with regular smoking at follow-up. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

Lastly, permissive and neglectful parenting styles were associated with having used illicit drugs at follow-up in the bivariate analyses. However, as can be seen in figure 18, these associations did not remain statistically significant in the regression models. Furthermore, none of the other parental factors such as regular drinking or smoking by parents, or provision of alcohol by parents, were significantly associated with illicit drug use at follow-up. The only factors that remained significantly associated with illicit drug use at follow-up were having deviant peers, which had showed a positive and non-linear association (p = 0.03, see figure 1 in study III), having been drunk at baseline, and delinquency.

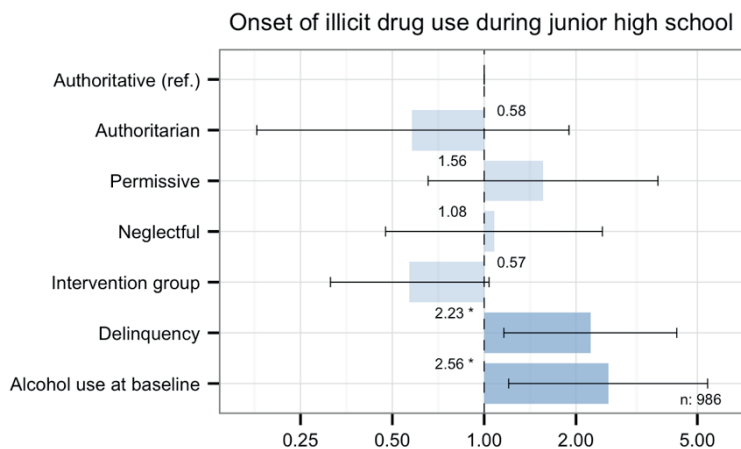**Figure 18.** Factors associated with having used illicit drugs at follow-up. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

Post-hoc analysis

We conducted four sets of post-hoc analyses to assess the generalizability of the results. In the first set of analyses, we compared the intervention group to the control group on all baseline variables to identify any differences. Adolescents in the intervention group reported a slightly lower mean score on the deviant peers measure (7.7 vs. 8.2 out of 0-24 pts. p = 0.02), but none of the other baseline variables differed significantly between the groups. In the second set of analyses, we aimed to assess whether the baseline samples differed from the final analyzed samples. Report of daily smoking in parents, as well as smoking at baseline, was significantly associated with being excluded from the analyses of all outcomes. There were also other statistically significant associations in expected directions for all of the outcomes except for lifetime drunkenness, so that those who reported "risk variables" (delinquency, deviant peers, substance use, etc.) had a higher risk of being excluded from the analyses. We conducted adjusted logistic regression analyses, which showed that the variable that was most consistently significantly associated with being excluded from the analyses was cigarette use at baseline, followed by having been drunk at baseline and reporting daily smoking in parents.

The third set of post-hoc analyses were a number of sensitivity analyses to determine the impact of the adolescents lost to follow-up on the results. We first coded all those lost to follow-up as positive on each outcome measure, and the same regression models were then applied. We then coded all those lost to follow-up as negative on each outcome measure, and again applied each of the regression

models. The differences in the estimated coefficients, standard errors, and p-values were minimal compared to the data presented above and in the paper. The only exception to this, regarding parenting styles, was that in the analysis in which those lost to follow-up were assumed to be negative to all substance use outcomes, authoritarian parenting style was no longer significantly associated with having been drunk more than ten times at follow-up (p = 0.18).

Lastly, we constructed post-stratification weights using census data. In short, this is a process to ensure that the proportions of certain demographic indicators in the analyzed sample match the proportions reported in the census data (Little, 1993). The sample was first stratified in eight strata based on data on country of birth, country of parents' birth and living with both biological parents. Eight strata were thus created and census data from SCB was used to calculate the population proportions of each stratum (SCB, 2015b). The sample was then weighted so that the sample proportions matched the population proportions. All of the regression models were run again with the weights taken into consideration. The results were highly similar regarding odds ratios, standard errors, and p-values. In the weighted analyses, reporting authoritarian parenting style at baseline was associated with lower odds of reporting regular smoking at follow-up (OR 0.5, 0.2-0.9, p = 0.03). This might be compared with the results of the main analysis in which a similar, yet not statistically significant, association was reported (OR 0.6, 0.3-1.1, p = 0.11).

Study IV

In the sample of Swedish and Danish young adults in the ages 18-30, using weighted data, 15.3 reported binge drinking, and tobacco and illicit drug use were reported by 32.1 percent and 6.8 percent, respectively. The rates of reported use per country are shown in figure 19. Binge drinking was more common in Sweden (p < 0.001) while illicit drug use was more common in Denmark (p = 0.01). There were no apparent differences between the countries in tobacco use. However, the tobacco use item included snus in the Swedish questionnaire, but not in the Danish counterpart.
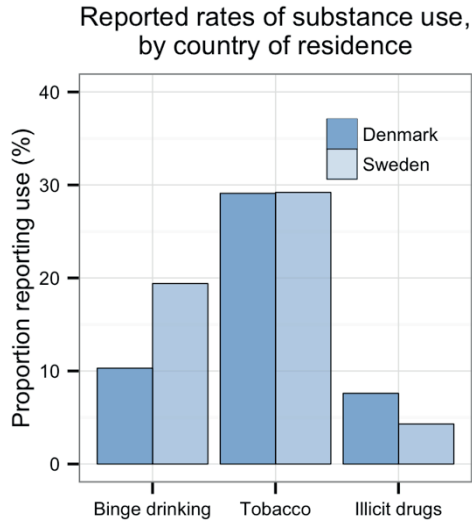
Figure 19. Study IV: Reported rates of substance use, by country of residence.

Tobacco use in young adulthood was associated with several predictor variables. Figure 20 below shows the adjusted odds ratios from the regression model with tobacco use as the dependent variable. All of the early risk behaviors, i.e. alcohol use at age 13 and antisocial behavior and illicit drug use at age 15, were associated with tobacco use in young adulthood. Furthermore, having no tertiary education and having used illicit drugs in the past year were also associated with tobacco use.

Factors associated with tobacco use in young adulthood
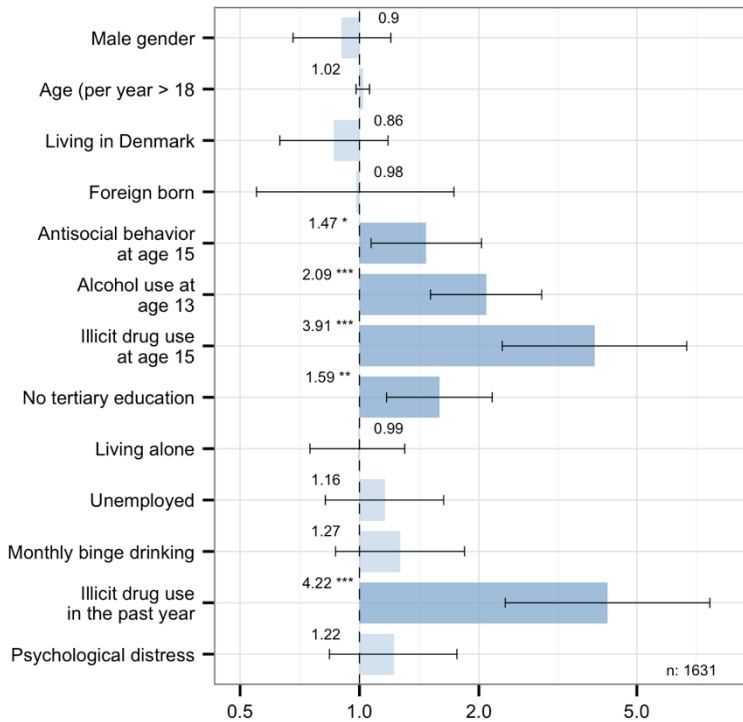
Figure 20. Factors associated with tobacco use in young adulthood. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

In figure 21 below, factors associated with binge drinking at least 12 times per year are shown. Living in Denmark and reporting antisocial behavior at age 15 were significantly associated with lower rates of reported binge drinking in young adulthood. None of the other predictor variables were significantly associated with binge drinking.
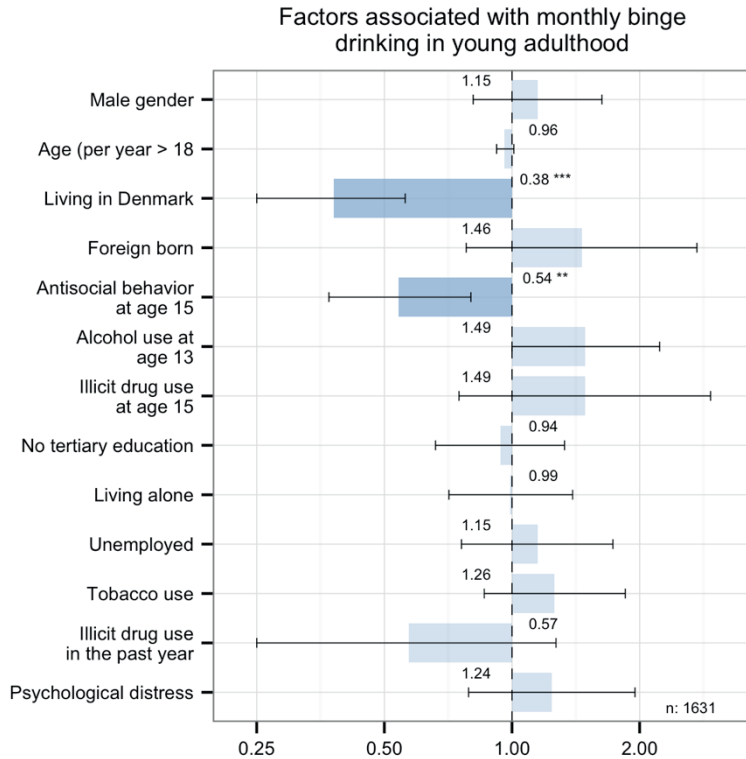
Figure 21. Factors associated with monthly binge drinking in young adulthood, subgroup analysis of those who reported ever having drunk 12 drinks of alcohol during any one-year period. Adjusted OR's (bars) and 95% confidence intervals (lines). * = p<0.05, ** = p<0.01, ***, p<0.001.

As discussed in the methods section, we had reason to suspect that some of the study participants might have misunderstood one of the items on alcohol use. We therefore conducted a second regression model, in which only the subset of individuals who reported having drunk at least 12 drinks of an alcoholic beverage during any one-year period were included (n = 1,337). The results regarding estimated odds ratios, standard errors and p-values were highly similar in the subgroup analysis, and specific results are therefore not reported here.
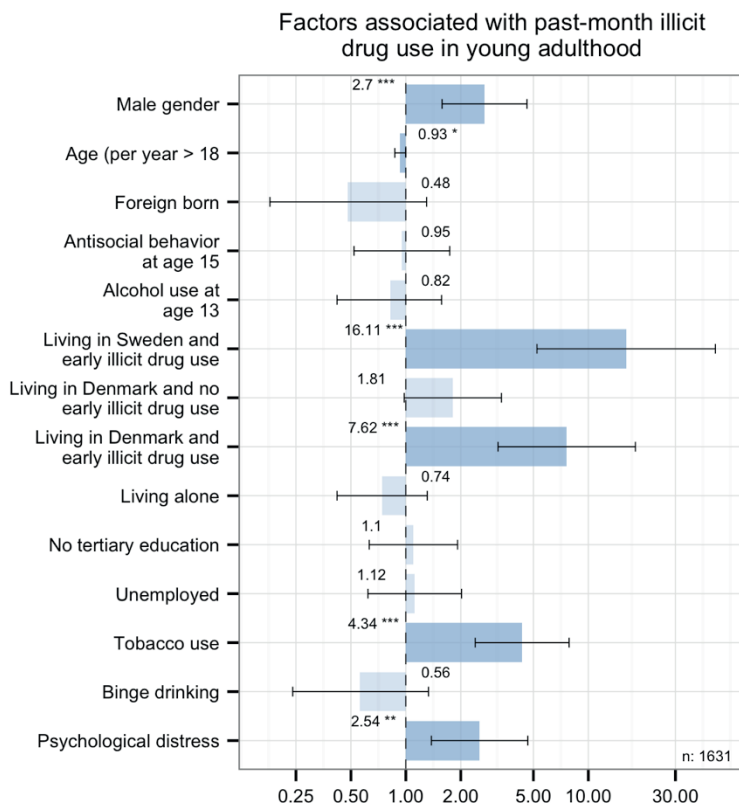
Figure 22. Factors associated with illicit drug use in the past 30 days in young adulthood. Adjusted OR's (bars) and 95% confidence intervals (lines). * = $p<0.05$, ** = $p<0.01$, ***, $p<0.001$.

Illicit drug use in young adulthood was defined as reporting use of any illicit drugs in the past 30 days, as described in the methods section. In the model selection process described in the methods section, the interaction term between illicit drug use at age 15 and country of residence significantly improved the model and was thus included in the final model. The results of the regression model are shown in figure 22 above. Male study participants, as well as those who reported tobacco use and psychological distress, were more likely to report illicit drug use in the past 30 days. Furthermore, because the interaction term between illicit drug use at age 15 and country of residence was significant, we chose to create a categorical variable consisting of the four combinations of these two variables. The reference category was living in Sweden and not reporting illicit drug use at age 15, and the three comparison categories can be seen in figure 22. Living in Denmark and not reporting illicit drug use at age 15 was not associated with an increased risk of illicit drug use in the past 30 days, but illicit drug use at age 15, regardless of

64

country of residence, was associated with current illicit drug use. As can be seen in figure 22, the odds ratio of this effect was much larger for the Swedish study participants than for the Danish study participants. This is the effect of the interaction described above, and this difference between was statistically significant ($p < 0.01$). This means that, while early onset of illicit drug use is a risk factor for subsequent illicit drug use in young adulthood in both countries, early onset of illicit drug use seems to have a higher effect on subsequent illicit drug use in Sweden than in Denmark.

Discussion

Methodological considerations

Study I

The first paper was based on data from a survey on alcohol and drug habits in the general Swedish population. The overall weighted response rate was 52 percent. This is comparable to similar surveys, though in the lower range (Degenhardt, Chiu, & Sampson, 2007; Bränström & Andréasson, 2008; Fischer et al., 2010; Jungerman, Menezes, & Pinsky, 2010; Roxburgh, Hall, & Degenhardt, 2010). The strengths of this cross-sectional study are the large number of study participants (n = 22,095) and the fact that the general Swedish population served as the sampling frame, which means that the results are reasonably representative of the Swedish population. Furthermore, AUDIT has been thoroughly validated for detecting hazardous alcohol use (Berner et al., 2007), and the use of this instrument is a major advantage of this study.

A consequence of a lower response rate may be that risk behaviors such as hazardous alcohol use and illicit drug use might be underestimated because individuals with these risk behaviors may be less likely to respond to the questionnaire. The analysis of non-responders failed to identify any differences in substance use between the responders to the original questionnaire and those who responded to the non-responder survey. However, since only 53 percent responded in the analysis of non-responders, selection bias still cannot be ruled out. Another problem related to the study design is that study participants may have under-reported their use of illicit drugs. However, while the use of so-called hard drugs such as stimulants and opioids is often underreported in population surveys, estimates of cannabis use in population surveys seem to be more accurate (Rehm, Room, & van den Brink, 2005).

The main measurements of interest in this study were cannabis use and hazardous alcohol use. We chose to define active cannabis use as those who reported any use in the past 12 months since those who did not progress beyond the experimental stage are not likely to suffer any consequences of their previous cannabis use. Among active cannabis users, frequent cannabis users were separated from occasional cannabis users to differentiate between those who have higher levels of

cannabis use, known to be associated with adverse outcomes and those with lower levels of use, to study any differences between these groups. Ideally, diagnostic criteria of cannabis use disorders, or perhaps a detailed assessment with, for example the Timeline Follow Back technique (Sobell & Sobell, 1996), would have been used, but in the absence of such possibilities, we consider our methodology a reasonable compromise.

We decided against using the sample weights in the regression models because they were constructed in such a way that the sample sizes would be inflated. The sample weights were constructed in this manner so that the prevalence of substance use in the general Swedish population could be easily estimated. However, using the weights in the statistical models would have had the unwanted effect that standard errors, and thereby p-values, would be greatly underestimated, leading to a dramatically increased risk of type 1 errors. It might be argued that the weights could be recalibrated and used in our analyses, but since interaction terms were not considered, the results should not be substantially different than those reported in the study.

Study II

The second and third papers in this thesis were based on data from a pseudo-experimental longitudinal study on the effects of evidence-based prevention programs in 21 junior high schools. Eleven of the schools were selected for the intervention and ten schools served as controls. A total of 1,398 of the 1,436 eligible adolescents (97.4 percent) participated in at least one of the four waves of the study. The strengths of this study design are that a relatively large cohort of adolescents and their parents were assessed over a period of over 2.5 years (autumn semester in the 7th grade to spring semester in the 9th grade), and that the questionnaires used provided detailed information on a range of important aspects of adolescent life and parent-child relationships.

However, as the schools were not randomly selected, and eleven of the schools were under the intervention condition previously described, the representativeness of the data for the general junior high school population might be questioned. In both of the papers, the experimental group variable (intervention/control) was adjusted for in the multivariate analyses, which mitigates the potential problem of intervention effects. However, no effects of intervention status on the outcome measures were found.

Another potential limitation is the risk of selection bias caused by non-response to the questionnaires. Adolescent response rates range from 77 to 88 percent, and parental response rates range from 65 to 80 percent (figure 1, p. 29). The combined response rates (both the adolescent and their parents have answered the questionnaire at a particular wave) range from 62 to 71 percent. An analysis of

those lost to follow-up conducted in study III indicates that those lost to follow-up are more likely to report almost all of the risk variables included in that study. This implies that those individuals who do not respond to questionnaires are more likely to use substances and might be involved in other risk behaviors. This is a reasonable assumption, which limits the generalizability of the results. However, in the sensitivity analysis conducted in study III, described in the results section, we found that irrespective of whether those lost to follow-up were assumed to have used substances or not, the results were not substantially different from those reported in the main analyses. We also performed a post-stratification weighting using census data from SCB, and ran the regression models again, as described in the results section. The results remained largely unchanged relative to the results in the main analyses, with the possible exception of the influence of authoritarian parenting style on regular smoking at follow-up. However, in absolute terms, the changes in standard error and estimated odds ratio were small. The results of the several sets of post-hoc analyses performed in study II thus indicate that the issues related to possible selection bias do not influence the results substantially.

A limitation related to the measurements used in the second and third papers is the possibility that adolescents might under-report substance use. The issue of validity of self-report has been studied by comparing self-report to analyses of urine or blood samples, and though the methodologies have varied and the results have been mixed, they indicate that there may be a certain degree of under-reporting (Williams & Nowatzki, 2005; Comasco et al., 2009; Delaney-Black et al., 2010). It might therefore be assumed that there is some under-reporting of adolescent substance use. Parental report, on the other hand, should be much less prone to misclassification, because the items regard parental beliefs about their children's substance use, and it is hard to imagine why parents would respond differently than what they actually believe.

Parental knowledge was defined by parents' reporting of being aware that their child used substances. There are very few cases of parents who report substance use, where the adolescent denies substance use. The major risk for misclassification bias is thus that some individuals, whose parents are unaware of their substance use, are excluded from the analyses. This means that while the levels of parental awareness reported in the present study are low, the true levels of parental awareness of adolescent substance use might be even lower.

In the second and the third studies, the study participants are nested in classrooms, schools, and cities. This would allow for a multilevel design where random effects of classrooms, schools, and cities could be considered. However, such analyses are complex, and the results might be difficult to interpret, so we settled for a simpler and more approachable analysis strategy.

Study III

This study is based on the same data set as the second study, and all methodological considerations that relate to the study design that was discussed above apply equally to this study. The main measures of interest in this study were the parenting style categories at baseline and the adolescent substance use outcomes at follow-up in the 9th grade. This study has the same strengths as study II, namely that a relatively large cohort of adolescents was followed during the course of junior high school, and that the questionnaires provided detailed information on substance use and other important aspects in the lives of adolescents. A major contribution of this study is the inclusion of a range of well-known risk factors for adolescent substance use in the multivariate analyses. Furthermore, this study benefits from using the same operationalization of parenting styles as in several other studies, thereby prioritizing facilitation of comparison to the existing research before trying to break new, theoretical ground regarding the definition of parenting styles. Finally, another strength of this study is the comprehensive diagnostic post-hoc analyses performed in order to ascertain the reliability of the results.

The possibility of under-report of substance use was discussed above, and is an issue also in this study. There is a theoretical possibility that there may be an association between tendency to under-report substance use and perceived parenting style. However, testing this hypothesis is not possible under the current study design, and we are unaware of any studies that have addressed this hypothesis.

The parenting style categories were constructed by first creating scales that reflect the two major aspects of parenting styles, demandingness and responsiveness, and then by dichotomizing each of the scales. This gives the four combinations of high or low on each of the scales, respectively, as described in the methods section. The advantages of this approach are that these parenting styles are supported by theory, and that the categorical approach facilitates comparison to previous studies in the same field of research. An alternative approach might be to use the scales as continuous variables in the regression models. However, since there is no reason to assume that they would have linear effects on the outcome variables, regression splines, as discussed in the methods section, might be used. This approach is already used for the deviant peers variable in the analysis of illicit drug use at follow-up, as previously discussed. However, there may be interactions between the two parenting style aspects, and a more complicated model would be needed, in which demandingness and responsiveness would be analyzed as a two-dimensional curve. This is a complex analysis strategy and the results may be difficult to interpret and compare to previous research (Zuur et al., 2009). We

therefore chose to use a simpler model used in a large body of previous research (Becoña et al., 2012; Čablová et al., 2014).

Study IV

This paper based on data from the *EU Meds Study*, an online cross-sectional survey of young adults recruited via quota sampling. The main strengths of this study are the relatively large number of participants (n = 1,916) and the detailed information on substance use and potential risk factors, including early onset of risk behaviors known to be associated with substance use in young adulthood. Including the retrospective variables early onset of alcohol use and illicit drug use, and antisocial behavior at age 15, allows for studying the association between early risk behaviors and current substance use outcomes.

In this study, the main measures of interest were the substance use and early onset of risk behavior variables. We were interested in studying risk behaviors in young adults. Current smoking, binge drinking, and illicit drug use in the past 30 days were used as dependent variables in the analyses. To minimize the problems with the binge drinking variable as described in the methods section, we conducted a subgroup analysis of those who reported having ever had 12 drinks of alcohol during any one-year period. However, this subgroup analysis showed almost identical results as the main analysis. Another problem with the alcohol variables was that the amount of alcohol in a drink was not specified, which means that 'a drink' might be interpreted differently between individuals.

Perhaps as a consequence of these problems, the Danish study participants reported much lower rates of binge drinking, as defined in the present study, than the Swedish study participants. This is surprising because Denmark has a higher alcohol consumption per capita than Sweden, as well as a higher proportion of heavy episodic drinking in the past 30 days (29 percent compared to 24 percent) (Organisation for Economic co-operation and Development [OECD], 2015; WHO, 2015). Finding data representative of this specific age group has been difficult. In a study, using data from 2000-2005, binge drinking among young adults did not differ substantially between Sweden and Denmark (Plant et al., 2010). The levels of binge drinking of both Swedish and Danish young adults in that study are slightly higher than the levels reported by Swedish participants in the present study. These findings lead us to believe that it is mainly under-reporting of binge drinking among the Danish study participants, rather than over-reporting by the Swedish study participants, that causes the unexpected difference between Swedish and Danish study participants. Regardless, this makes the validity of the binge drinking variable, as well as the regression analyses that use binge drinking as the outcome measure, somewhat questionable. While the prevalence of reported binge drinking raises questions, the prevalence of tobacco use and illicit drug use

among the Swedish and Danish study participants are in reasonable agreement with national data from each country (Danish Health and Medicines Authority, 2013; Public Health Agency of Sweden, 2015; Danish Health and Medicines Authority, 2015). Our hypothesis is that this result is an artifact created by the study design. However, examining this matter more closely is outside the scope of the present study.

Representativeness of the samples

The data sets used in the papers in the present study, to some extent, reflect aspects of the Swedish general population. In order to evaluate the generalizability of the results, it is relevant to compare the data sets used to other samples that might be considered to be representative of the same aspects of the Swedish general population. I will therefore briefly compare each of the samples used in this thesis to national data, especially regarding use of licit and illicit substances, since that is the main focus of this thesis.

Study I: National survey of the Swedish general population, 2008

This large study was a national survey designed to be representative of the general Swedish population (FHI, 2010). However, comparing the results from this study to other sources of nationally representative data might still be informative. In the present study of individuals 15 to 64 years of age, 22 percent reported hazardous alcohol use. In the 2008 National survey of public health, 17 percent of individuals 16 to 84 years of age were considered as risk consumers by the same definitions, using AUDIT, as in the present study (Public Health Agency of Sweden, 2015). Though not presented in study I, 14 percent reported daily smoking and 12 percent reported non-daily smoking. In the 2008 National survey of public health, among individuals in the ages 16 to 84 years, 13 percent reported daily smoking and 11 percent reported non-daily smoking (Public Health Agency of Sweden, 2015). In the present data set, cannabis use was reported by three percent in this data set. This might be compared to 2 percent in the nationally representative data in the age range 16 to 84 years (Public Health Agency of Sweden, 2015).

In summary, while the results reflect partially different populations, the reported rates of substance use in these two nationally representative surveys are highly similar.

Study II and Study III: 21 Junior High Schools sample, 2004-2007

To assess the representativeness of the sample for the general population of adolescents in junior high school, the reported rates of substance use among adolescents might be compared to data from national surveys. Though recent data are available (CAN, 2015), it may make more sense to compare our data to data contemporary with the study. In the 2008 and 2012 ESPAD reports on 15 to 16 year olds, data are reported from the 2007 and 2011 ESPAD surveys and from the 2007 and 2011 Swedish national surveys on the same age group (Hibell et al., 2009; Hibell et al., 2012). A comparison between the rates of substance use reported in the 21 Junior High School data set and these four data sets is shown in figure 23. As can be seen in figure 23 below, the reported rates of cigarette use are highly similar across the data sets.
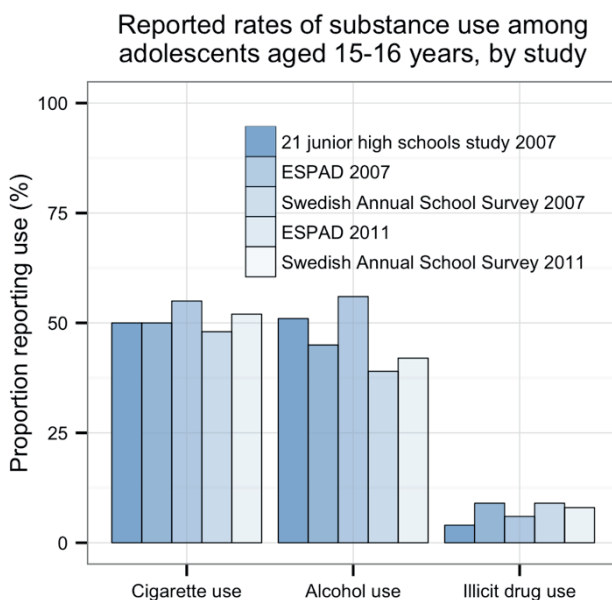
Figure 23. Studies II-III: Reported rates of substance use compared to results from national surveys.

The proportions reporting having ever been drunk are also similar, but somewhat higher in the data sets from 2007 than 2011. This may reflect the fact that alcohol consumption among Swedish adolescents has decreased steadily in the past 15 years (CAN, 2015). The representativeness of the sample for the general population of adolescents in junior high school, and their parents, might thus be questioned on the basis of the selection of schools included in the study and the rates of participation in the study. While we make no claim that these results are

fully representative, as discussed in study III, the levels of substance use in the sample are comparable to those reported in the national surveys (Hibell et al., 2012; CAN, 2015). This indicates that the sample in the studies probably does not differ much from the general population of adolescents in junior high school.

Illicit drug use was reported by four percent of the adolescents in the 9th grade in our study. This is lower than both the ESPAD reports for 2011 (six percent of the girls and twelve percent of the boys) and 2007 (seven percent of the girls and ten percent of the boys), as well as the Swedish annual school surveys for 2011 (six percent of the girls and nine percent of the boys) and 2007 (five percent of the girls and six percent of the boys).

Thus, there seems to be an underestimation of illicit drug use in the present study. However, this may be due to a potential effect of the experimental condition on adolescent illicit drug use in the intervention schools. Indeed, four percent of the adolescents in the intervention schools reported illicit drug use in the 9th grade, compared to seven percent in the control schools ($p = 0.03$). The reported prevalence of illicit drug use among adolescents in the control schools is more in line with the findings in the other surveys referred to above. Comparisons with other adolescents are easy for 9th graders, but more difficult for earlier grades, as to our knowledge there is not the same amount of systematically collected data from these age groups.

In summary, comparison between our data and the data presented in the ESPAD report support the notion that our sample is generally representative for the general population of adolescents in junior high school in Sweden, in particular for adolescents in the 9th grade.

Study IV: EU Meds Study, 2014

Some concerns have been raised regarding the validity of quota sampling as substance use may be underestimated (Guignard et al., 2013; Yang & Banamah, 2014). Comparisons to nationally representative surveys are therefore especially motivated in this case. As has previously been discussed at length in the methodological considerations section, binge drinking seems to be underestimated in this sample, especially among the Danish study participants, compared to nationally representative results.

Tobacco use, including *snus* (Swedish, a form of oral tobacco) in the Swedish part of the sample, was reported by 29 percent of both the Swedish and Danish study participants. This is slightly lower than data from a 2014 survey on the Swedish general population, in which 35 percent in the age range 17 to 29 years reported any tobacco use, including *snus*, in the past 30 days, and 22 percent had smoked cigarettes in the past 30 days (Henriksson & Ramstedt, 2015). In contrast, in data

from a national Danish survey from 2014, 20 percent in the age range 20 to 29 years reported being cigarette smokers (Sundhedsstyrelsen 2015). The results thus seem reasonably comparable, at least for the Swedish study participants, but tobacco use seems to be over-reported by the Danish study participants compared to national data.

Five percent of the Swedish and eight percent of the Danish study participants reported cannabis use in the past 30 days. This might be compared to Swedish national data on 16 to 29-year-olds, where two percent reported cannabis use in the past 30 days (Public Health Agency of Sweden, 2015), and Danish national data on 16 to 34-year-olds, where six percent reported cannabis use in the past 30 days (Danish Health and Medicines Authority, 2013). Cannabis use thus seems over-reported in the present study compared to national surveys.

In summary, among the Swedish study participants, binge drinking and tobacco use show reasonable agreement to national data, but cannabis use is clearly more frequently reported in our data. Among Danish study participants, binge drinking and tobacco use seems underestimated compared to national data, and cannabis use is somewhat more frequently reported. Though it is not clear whether these discrepancies are consequences of the quota sampling methodology, the questionnaire design, or the fact that the study participants were recruited from the metropolitan areas of each country, these differences should be kept in mind when interpreting the results of this study.

Main findings

Patterns of substance use among cannabis users

The main findings of the first study, based on the cross-sectional sample of the Swedish general population, were that, while hazardous drinking, illicit drug use, and prescription drug use are much more common among cannabis users than among non-users, frequent cannabis users more often report illicit drug use than occasional users, but less often report hazardous drinking.

Comparing groups of cannabis users
All of the substance use variables were strongly associated with cannabis use in the multivariable analyses. Cannabis users in Sweden seem to be a problematic group with higher levels of other risk behaviors, related to substance use, than non-users. While cannabis use has been linked to a range of harmful consequences (Hall, 2009), the direction of causality can often be difficult to determine, and the propensity to use cannabis might be influenced by other factors, e.g.

socioeconomic status in childhood (Daniel et al., 2009), early psychiatric morbidity (Coffey, Lynskey, Wolfe, & Patton, 2000), peer and parental influence (Allen et al., 2003).

Among those who reported cannabis use in the past year, frequent cannabis use was more common in the older age group (30 to 64) when compared to the youngest age group (15 to 24). This is somewhat surprising, and may have several explanations. One hypothesis is that while most cannabis users quit some time after the age of 30, those who are heavy users are more likely to continue their use past this age. Another hypothesis is that some of the older cannabis users use cannabis to "self-medicate" for certain chronic conditions, and because of the perceived effect of the cannabis use, they use the drug regularly. Testing these hypotheses are outside the scope of this study, but further study of this group of cannabis users, especially of those who do not use other illicit drugs, is warranted.

Frequent cannabis users were more likely to report use of other illicit drugs than occasional users, a finding that has reported by previous studies (Miller & Plant, 2002; Fischer et. al., 2010; Swift et al., 2012). The frequent users were also more likely to be unemployed and have an income below the median, which supports the notion that frequent cannabis users are a problematic group with high levels of drug use and lower levels of social adaptation than occasional users.

The issue of alcohol and cannabis

Cannabis users reported much higher levels of hazardous alcohol use than non-users, with an odds ratio of 4.3 (3.7-5.0). However, when comparing frequent users to occasional users, the frequent users had a lower odds ratio of reporting hazardous alcohol use at 0.7, 0.4-0.95. This apparently nonlinear relationship between cannabis use and hazardous drinking is partially unexpected when our results are compared to those of other studies. In a study of 2,641 UK school students (Miller & Plant, 2002), heavy cannabis use, when compared to light cannabis use, was associated with several adverse alcohol outcomes. However, that study is based on a sample of adolescents 15 to 16 years of age, and the results are not adjusted for potential confounders, so the results are difficult to compare to the results in our study. In another study of 1,303 adult Canadian cannabis users (Fischer et al., 2010) it was found that the more frequent users had a lower rate of alcohol use in the past year, but a higher rate of daily alcohol use as well as higher rates of other substance use. These results do not necessarily contradict the results in our study, if the negative association between frequent cannabis use (compared to occasional use) and hazardous alcohol drinking is partially related to a higher rate of abstinence from alcohol use in the group of frequent cannabis users. In a longitudinal study of 1,756 Australian adolescents followed to young adulthood, it was found that reporting any cannabis use at baseline was associated with subsequent high-risk alcohol use. However, among those who reported cannabis

use at baseline, reported level of cannabis use was not associated with subsequent high-risk alcohol use (Swift et al., 2012).

Taken together, the results from the present study, and the studies by others described above, warrant further investigation on the topic of alcohol and cannabis use. It might be hypothesized that there is a subgroup of frequent cannabis users who abstain from alcohol use entirely, and perhaps also from other illicit drugs. It may also be that while hazardous drinking is less common among frequent cannabis users, the same association may not necessarily hold true for alcohol dependence. The association between frequency of cannabis use and daily alcohol use as reported by Fischer and colleagues (2010) might indicate such an association. Testing these hypotheses might be aims for future research in these matters.

The role of parents in adolescent substance use

The second and third studies of this thesis focus on the role of parents in adolescent substance use. In the second study, the focus is on what parents know about their substance use and what factors are associated with parental knowledge. In the third study, the focus is on the importance of parenting styles for adolescent substance use, and what other factors contribute to adolescents' decisions to use cigarettes, alcohol, and illicit drugs. The results show that parents are generally unaware of their children's substance use, and that general parenting styles do not seem to be as important as provision of alcohol by parents and other factors related to parents and peers.

Adolescent substance use patterns

The second and the third studies of the present thesis were based on the same data set. The use of cigarettes, alcohol, and illicit drugs was lowest in the autumn semester of the 7th grade and, as can be seen in figure 8 (p. 51) in the results section, the reported rates of all substance use increased during the course of junior high school. While difficult to compare directly because of slight differences in the items (e.g. life-time drunkenness vs. lifetime alcohol use, or vs. binge drinking in the past year), the results in this data set seem comparable with national Swedish data (CAN, 2015), though the use of illicit drugs was somewhat lower in our data set (5 percent compared to 8 percent).

Parental unawareness of adolescent substance use

We found that parents generally knew very little about their children's substance use behaviors. Between 6 to 26 percent were aware that their child had been drunk. This is lower than what was reported by Engels and colleagues (2007), 16 to 49 percent, and by Williams and colleagues (2003), 34 percent, but considerably

higher than what was reported by Chang and colleagues (2013), six percent, and seemingly comparable to what was reported by Guilamo-Ramos, Jaccard, Turrisi, Johansson, and Bouris (2006), though no figures that permit calculation of sensitivity were presented. Parental awareness of tobacco use and illicit drug use has been studied in fewer studies than parental awareness of alcohol use. The results of the present study indicate a similar degree of parental awareness of tobacco use to what was reported by Williams and colleagues (2003), 39 percent, and Chang and colleagues (2013), 32 percent. Parental awareness of illicit drug in the present study, ranging from 5 to 12 percent, was similar to what was found by Williams and colleagues (2003), 11 percent. In another study by Langhinrichsen and colleagues (1990), direct figures are unavailable for comparison, but they report that 20 to 23 percent of parents underestimate their child's tobacco use, 22 percent underestimate alcohol use, and 15 percent underestimate marijuana use. Using the data from study II, 23 to 38 percent of parents underestimate their child's alcohol use, 17 to 37 percent underestimate alcohol use, and 1 to 4 percent underestimate illicit drug use. However, these results are difficult to compare, because percentages of parents who underestimate their children's substance use naturally depend on the prevalence of substance use among adolescents. The samples and measurements used to assess substance use vary across the different studies, making direct comparisons difficult.

It may be concluded that parental awareness of adolescent substance use does not seem to differ substantially from other countries, possibly with the exception of the parents in Taiwan, who seem to know very little about their adolescent children's alcohol use (Chang et al., 2013).

Adolescent gender, school grade, frequency of substance use, and school performance were associated with parental awareness. Parents were more likely to be aware of their children's alcohol and cigarette use in the 9th grade than in the 7th grade. This might reflect an increased awareness in parents that older adolescents may come in contact with substances, but it also that older adolescents may feel more secure in disclosing information on substance use to their parents. Frequency of use was positively associated with parental awareness for both alcohol use and cigarette use. This is perhaps unsurprising, as more frequent use should increase the risks of being caught red-handed. Parents were generally more aware of their daughters' alcohol use than of their sons' alcohol use, but this gender difference was not seen for cigarette use. This might reflect a greater level of closeness and trust between daughters and their parents, but an alternative hypothesis is that parents on average tend to monitor daughters more closely, possibly because of the perceived risk of e.g. sexual abuse during an incapacitated state caused by alcohol intoxication. This is of course highly speculative, but it might be an interesting line of future research.

A number of other factors may be hypothesized to influence parental awareness of substance use in adolescents. The considerable differences in parental awareness

of substance use reported in the literature indicate that cultural differences in the views on adolescent substance use might potentially influence parental awareness. Furthermore, it seems likely that parents' own use of substances might influence the willingness of adolescents to disclose information of their own substance use. Lastly, there is also the possibility that factors such as parental monitoring, as well as trust and respect between parent and child, may influence parental knowledge. Testing some of these hypotheses might be a direction for future research.

The limited influence of parenting styles on adolescent substance use

The main finding of the present study was that parenting styles had a limited influence on adolescent substance use. Previous research has in general shown that authoritative parenting style is associated with the best substance use outcomes in adolescents and neglectful parenting style with the worst (Becoña et al., 2012; Čablová et al., 2014). However, important risk factors have often been missing from the analyses, and in the present study, when taking several such risk factors into consideration, the influence of parenting styles on adolescent substance use is limited. When studying the importance of parental awareness for adolescent substance use in a cross sectional setting, there is an obvious risk of bi-directional causality. Perhaps some of the parents, whose adolescent children start to use substances, change their behavior in ways that they think represent the best strategy to handle the situation, for example by increasing the amount of control and supervision toward the child. In the present study, we tried to account for this by using data from a study with a longitudinal study design. It is therefore more relevant to make comparisons with other longitudinal studies conducted in a similar manner.

The influence of baseline parenting styles, as conceptualized by Baumrind, Maccoby, and Martin (Baumrind, 1967; Maccoby & Martin, 1983) on adolescent substance use at follow-up in the 9th grade, over 2.5 years later, was largely negligible. In the main analyses, the only exception was that authoritarian parenting, compared to authoritative parenting, was associated with lower odds (OR 0.4, 0.2-0.7, $p < 0.01$) of having been drunk more than ten times at follow up. In the post-hoc analyses using census-weighted data, authoritarian parenting was also found to be protective against regular smoking at follow-up (OR 0.5, 0.2-0.9, $p = 0.03$).

A number of cross-sectional studies have shown that there are associations between parenting styles and adolescent substance use, most commonly lower rates of substance use in adolescents who perceive their parents as authoritative, and higher rates of use in those who perceive their parents as neglectful (Becoña et al., 2012; Čablová et al., 2014). Previous longitudinal studies on this issue have reported quite varying results. In a study on 347 Icelandic youths (Adalbjarnardottir & Hafsteinsson, 2001), aged 14 at baseline and 17 at follow-up, it was found that adolescents who perceived their parents as authoritative were less

likely to report use of alcohol or illicit drugs at follow-up than those who had authoritarian or neglectful parents. No associations between parenting styles and tobacco use at follow-up were found. In another study of 339 Scottish adolescents (Shucksmith et al., 1997), aged 13 to 14 years at baseline and 15 to 16 years at follow-up, authoritative parenting was associated with lower rates of alcohol use at follow-up, while authoritarian and neglectful parenting was associated with higher rates of alcohol use. In a more recent study on over 2,000 American adolescents in grades 7 to 12 at baseline (Shakya et al. 2012), followed-up 1-2 years later, perceived authoritative parenting at baseline was associated with lower rates of past-year alcohol use at follow-up, but no associations were seen between parenting styles and past-year binge drinking, smoking in the past month, or marijuana use in the past month.

The differences between the present study and the previous studies discussed above may have different causes. The studies include different substance use outcomes, different sets of predictor variables, and different items on parenting style aspects. Different methods were also used for creating the parenting style categories. The present study used median split, as used by Shakya and colleagues (2012), while the two earlier studies used tertiary split (Shucksmith et al., 1997; Adalbjarnardottir & Hafsteinsson, 2001). All of these studies are conducted in different cultural contexts, and it is possible that there is an influence of cultural factors in perception of parenting styles as well as in the effect of parenting styles for adolescent substance use outcomes. In a previous Swedish study of the association between parenting styles and adolescent substance use (Stafström, 2014), using a cross-sectional design with 5,000 students in the 9th and 11th grades, the authors found that authoritarian parenting was associated with worse alcohol use outcomes than authoritative parenting, a finding that does not support the results from the present study.

The present study indicates that parenting styles seem to have little influence on substance use during junior high school, with the possible exception of authoritarian parenting, as perceived by Swedish adolescents, which may be associated with lower rates of alcohol use and regular smoking.

Other influences on adolescent substance use behavior

While the influence of the general style of parenting was found to be limited, other aspects of parental behavior were more influential for adolescent substance use. Provision of alcohol by parents was associated with having been drunk and reporting regular smoking at follow-up, and also with having been drunk more than ten times though not statistically significant at the 0.05 level (p = 0.06). The association between provision of alcohol by parents and adolescent initiation of alcohol use, as well as levels of alcohol use, is in line with previous studies on this topic (Ryan et al., 2010), but the association between provision of alcohol and adolescent regular smoking is less well known. This might indicate that parents

who are willing to supply alcohol to their children have more lax attitudes toward adolescent substance use in general, which may increase the risk of regular smoking. While parental daily smoking was associated with regular smoking at follow-up, parental daily smoking or regular drinking was not associated with any of the other substance use outcomes. This is somewhat surprising, as parental alcohol use has been shown to be associated with age of onset of alcohol use and levels of alcohol consumption (Hawkins et al. 1992; Hill et al., 2000; Ryan et al., 2010). However, the item assessing parental drinking in the present study was quite non-specific as it regarded any use of alcohol once per week or more, and no information on the amounts of alcohol was specified. It seems plausible that a more detailed assessment of parental drinking might reveal an association between parental drinking and adolescent alcohol use outcomes.

Delinquency at baseline was the only predictor variable that was significantly associated with all of the outcome measures at follow-up. Youth delinquency might be seen as a proxy for conduct problems or antisocial behaviors, and indeed, several studies have shown a clear association between conduct disorder, antisocial behaviors, and juvenile delinquency (Holmes, Slaughter, & Kashani, 2001; Murray & Farrington, 2010). For example, in a study on 1,269 Vietnamese male twins (Sartor et al., 2007), it was found that conduct disorder (CD) was associated with earlier onset of alcohol use, and also with a more rapid progression from the onset of alcohol use to alcohol dependence. In another study on 2,361 American twins (Palmer et al., 2013), childhood ADHD, CD, and novelty seeking behavior, as well as adolescent substance abuse, were associated with substance dependence in young adulthood.

Association with deviant peers was associated with having been drunk more than 10 times, regular smoking, and illicit drug use at follow-up. These results are in line with previous research, which have identified having deviant and substance-using peers as one of the most important predictors for adolescent substance use outcomes (Allen et al., 2003). Having been drunk or having smoked cigarettes at baseline was associated with most of the substance use outcomes. This is to be expected as early onset of substance use has consistently been found to increase the risk of various substance use outcomes (Grant & Dawson, 1997; Grant, 1998; Grant & Dawson, 1998; Ellickson, Tucker, Klein & Saner, 2004; Windle & Windle, 2012; Spear, 2015).

Adolescent problem behavior associated with substance use in young adults

We found that tobacco use in young adulthood was associated with early onset of either alcohol or illicit drug use, and also with early antisocial behavior, and that early onset of illicit drug use was associated with illicit drug use in young

adulthood. These findings broadly agree with previous studies, which have found that early onset of substance use is one of the most important predictors for later substance use and substance use disorders (Grant & Dawson, 1997; Grant, 1998; Grant & Dawson, 1998; Ellickson et al., 2004, Windle & Windle, 2012; Spear, 2015). An unexpected finding was that early antisocial behavior was negatively associated with binge drinking in young adulthood. Previous studies have indicated that antisocial behavior is associated with higher levels of substance abuse and dependence in adulthood (Edwards & Kendler, 2012; Degenhardt et al., 2013). The consistency of this association in the literature and the questionable validity of the binge drinking variable make us hesitant to draw any conclusions from our results.

Furthermore, we also found that the interaction between country of residence and illicit drug use at age 15 was significant. This indicates that illicit drug use at age 15 may have a different effect on substance use in young adulthood in Sweden than in Denmark. More specifically, early onset of illicit drug use was associated with illicit drug use in young adulthood in both countries, but the association was stronger in Sweden. To our knowledge, this finding has not been reported previously. As reported elsewhere in this thesis, illicit drug use is more common in Denmark than in Sweden. The association found in the present study might thus reflect that illicit drug use, perhaps especially cannabis use, may be more strongly linked to early norm violating behavior, of which illicit drug use at age 15 can be said to be an example, in Sweden than in Denmark, which would explain this association. Testing this hypothesis further is outside of the scope of the present thesis, but it might be an interesting line of future research.

General conclusions

This thesis addresses a number of questions that are of importance because of the high levels of harms to individuals and to society caused by substance use. Risky and problematic substance use often starts in adolescence and may progress to substance use dependence in adulthood. The importance of the well-known risk factors for adolescent substance use is confirmed in two studies, one of them longitudinal and the other retrospective. Our longitudinal study demonstrates the limited influence of parenting styles for substance use outcomes, and it also shows that provision of alcohol by parents, as well association with deviant peers, are major contributors to subsequent substance use in adolescents. In the retrospective study, the importance of early risk factors for substance use in young adulthood is once again highlighted, which indicates that early onset of risk behaviors might exert an influence lasting way beyond adolescence. Furthermore, the co-occurrence of different types of substance use behaviors among young adults is

shown in both studies on adults. The paper that studies the extent of parental awareness of adolescent substance use shows that Swedish parents of adolescents in junior high school are generally unaware of their children's substance use behaviors. Finally, by studying patterns of substance use among groups of cannabis users in a large sample from the general population, attention is directed to the fact that despite the high levels of overlap in the use of different categories of substances, there may be distinct groups of substance users with different risks and needs for interventions.

Directions for future research

The papers included in this thesis studied substance use in adolescents and young adults from different angles. Alcohol is the most commonly used drug, and cannabis the most commonly used illicit drug in Sweden, as well as in many other western countries.

The general style of parenting did not seem to influence adolescents' decisions to use substances or to abstain. There seems to be a general trend that associations between parenting styles and adolescent substance use are more often found in cross-sectional studies, and in studies which adjusts for few confounders such as delinquency or association with deviant peers. The results from this thesis point in the same direction as other longitudinal studies that adjust for important confounders, as only marginal influence of parenting styles on adolescent substance use was found. This is not to say that parenting styles do not matter. It could be hypothesized that parenting styles have an indirect effect on adolescent substance use through adolescent delinquency and what peers the adolescent chooses to associate with. For example, children with neglectful parents may be more likely to engage in delinquent behavior and associate with substance-using and otherwise deviant peers, and as a consequence of this, rather than the parenting style in itself, the child may become more likely to experiment with substances of misuse. It may also be hypothesized that this effect of parenting styles may be more important in mid school than in junior high school. Future research might try to study long-term trajectories of parenting styles on substance use in adolescence when other factors are taken into consideration.

Early onset of substance use was found to be associated with worse substance use outcomes in later adolescence and young adulthood. These results were in agreement with the scientific literature, and highlight the importance of these early risk behaviors for later adverse substance use outcomes. While, naturally, causality cannot be fully assessed by these studies, the results nevertheless indicate the importance of early identification of individuals at risk. The papers in this thesis contribute to the knowledge about substance use trajectories from early

adolescence to later adolescence and young adulthood. The complexity of this issue is thus highlighted, because though there is a vast amount of literature on the subject and a broad consensus regarding specific issues, the picture is still patchy and it is difficult to determine, e.g., which children in mid-school will progress to substance use. Future research on the development of high-risk substance use behaviors and substance use disorders in young adulthood should thus aim for a broad scope of known and potential risk factors and modulators of risk, including the influence of parents and of peers, individual factors as well as hereditary and societal factors. To address these issues, there is a need for longitudinal study designs following young individuals from pre-adolescence up to young adulthood.

Parents generally seem to know very little about their children's substance use, a finding in previous studies that is now confirmed within a Scandinavian setting. Parental awareness might thus be important as a potential target for intervention programs aimed at reducing substance use in adolescents. Whether parental awareness of substance use might reduce the levels of substance use or prevent progression to higher levels of substance use in adolescents is a question warranting future research. This is a complex issue, which requires carefully planned longitudinal studies.

The finding that risk drinking is highly prevalent even in occasional cannabis users shows that it may be important to screen thoroughly for risky alcohol use and other illicit drug use in light cannabis users. We now know that even those cannabis users whose consumption might be considered as less harmful often have high levels of risk drinking and other illicit drug use which may be more harmful. The seemingly inverse relationship between frequency of cannabis use and levels of risk drinking might be an interesting line of future research, as there may be distinct groups of individuals with specific substance use patterns. If we could identify these groups more accurately and study their prognosis and treatment response, we might be able to better predict what interventions may be suitable for a given individual.

Implications for preventive strategies

While this thesis poses many questions, it also offers some more direct implications. For now, the results of this thesis indicate that parents should be restrictive with providing alcoholic beverages to their children, and that they should be attentive to delinquency and association with deviant peers, as these factors are important for the development of substance use behaviors. The results also show that parents know less than they think they do about their children's substance use, and this might motivate parents to try to enhance their awareness in this regard. Furthermore, the importance of early substance use behaviors for

subsequent substance use in young adulthood is confirmed, and this stresses the need for evidence-based prevention efforts targeted at adolescents. It may also be valuable in clinical practice to ask young adults about the age of onset of substance use, as this is such an important prognostic marker. Finally, the results suggest that it might be important to screen for hazardous alcohol use and other illicit drug use in cannabis users, even if the cannabis use in itself is presented as moderate, as these potentially problematic substance use behaviors are so prevalent among cannabis users.

Acknowledgements

This is my doctoral thesis, and it is the culmination of several years worth of research and studies. Yet I have not, and could not have, done it by myself. Throughout my time as a doctoral student, I have had great help from my supervisors, my other collaborators, my fellow doctoral students, and others.

I would first and foremost like to give my appreciation to my main supervisor Anders Håkansson. You took me in and believed in me from start when I approached you with my wish to start a research project. Despite your countless obligations and commitments, you have always somehow managed to be available and helpful. You have provided guidance throughout my education process, and you have also always had faith in me. You have also supported me and shown understanding when I needed it, and you have let me take a great deal of responsibility when I was ready for it. I cannot thank you enough for this period, and I'm certain that we will have a fruitful collaboration for many years to come.

I also want to give my appreciation to my co-supervisor Agneta Öjehagen, who has been incredibly helpful and quick in all stages of this process. Agneta has been inspiring and engaging, and she has demonstrated a relentless faith in my capacity to finish my studies and to write this thesis. We have not always agreed on all specific issues. Most of the times, she has been right and I have stood corrected and have learned from it, but in the few cases when she has been wrong, she has admitted this without hesitation and pride. This humble attitude, despite her seniority and experience, is admirable, and I hope that I can meet my future students with that same attitude.

Göran Nordström, also my co-supervisor, has had an important role, especially toward the end of my doctoral studies. Göran has given me great insights in linguistic issues and he has also contributed with a holistic perspective on my writings in this thesis. But most of my contacts with Göran have actually been in a different context, where we've had many intellectually stimulating discussions regarding scientific issues.

When I first became interested in starting a research project, I contacted Mats Berglund because. He directed me to Anders Håkansson, who had been his doctoral student several years earlier. We collaborated with Mats during my first years, and I have learned a lot, both intellectually and practically, from his vast experience and knowledge.

I would also like to thank Knut Sundell for several reasons. On a practical level, his generosity to let me work with a data set, of which he was the principal investigator, allowed me to work with research questions regarding substance use in adolescence, an area of research that interests me greatly. Perhaps more importantly, I have learned much from his stringency in research issues and his insightful views on different issues related to good scientific practice.

Peter Höglund collaborated with us for a while, and I want to thank him for the knowledge and experience he provided. I also suggested Peter as my mentor during my doctoral studies and he accepted. Though we haven't succeeded particularly well in meeting on a regular basis, I'm certain that he will continue to provide me with support and guidance even now, when the formal mentorship has ended.

I know Tove Abrahamsson since our time as medical students, and we have also gone through our doctoral studies together. I would like to thank her for her commitment and her linguistic rigor. Each time she has revised one of my texts, my first reaction has been that she has given me a lot of extra work due to her rigor, but each time I have worked my way through her comments, I have come to realize how much better my texts become thanks to her.

Disa Dahlman is a competent and resourceful colleague, and I would especially like thank her for her effectiveness in our collaboration.

I would like to thank Åsa Westrin, head of the research department, for providing access to the facilities of the department.

I would also like to thank Petrus Nietzson, my clinical supervisor at Beroendecentrum Malmö (Centre for Addiction, Malmö) even though he has not been directly involved in my research. With his experience and knowledge, and his passion for both patients and psychiatry as a clinical field, he has become the role model in my clinical practice and he inspires me to continue my clinical work.

In this regard, I would also like to thank the staff and colleagues at Beroendecentrum Malmö, the basis of my clinical practice and residency. My co-workers have always been interested and supportive, and they have always let me plan my schedule so that it will fit my research plans.

My parents have of course always been very important to me, and they continue to be important to this day. They have never demanded that I should pursue an academic career, and I have never felt any pressure from them, only encouragement. Instead, I have experienced freedom and a sense of letting me take responsibility, and perhaps it is precisely because of this that I have been able to come this far. I am grateful that my parents not only are my parents who I love, but also two of my closest and most important friends.

My grandmother, Marie Berge, deserves special appreciation in this context. She has always been an important driving force for my aspirations in the academic world, and though she can be harsh, I know that she's proud of me.

Last, but certainly not least, I want to thank my lovely and beloved girlfriend and partner Nana for having put up with my never-ending working, especially during the final phase of my doctoral studies. She inspires me, in so many ways, to think critically and be more creative, but also to be more open to new experiences. When I am together with her, her two children, and my own daughter, I am constantly reminded about what is most important in my life.

Populärvetenskaplig sammanfattning

Bruket av tobak, alkohol och narkotika står för en betydande andel av sjuklighet och dödlighet, världen över. Samtidigt går det potentiellt att påverka dessa konsekvenser, och en strategi är att fokusera på förebyggande arbete för att minska andelen människor som börjar använda dessa substanser. Debuten av rökning, berusningsdrickande och narkotikabruk sker som regel under tonåren. Bland svenska ungdomar har användningen av cigaretter och alkohol minskat under de senaste 10-15 åren, medan bruket av narkotika under samma tidsperiod har legat på relativt stabila nivåer. Den tidpunkt vid vilken debuten av substansbruk sker har visats ha stor betydelse för efterföljande utveckling av problematiskt bruk. Med anledning av detta riktar sig många förebyggande insatser mot ungdomar, men hittills har effekterna av dem varit begränsade. Det är angeläget att öka kunskapen om ungdomars mönster av substansanvändning och om olika faktorer som hänger samman med och påverkar ungdomarnas benägenhet att använda tobak, alkohol och narkotika. Denna avhandling berör detta område med ett särskilt fokus på substansanvändning hos unga, och består av fyra arbeten som utgår från tre olika datamaterial.

Arbete 1

I ett samarbete mellan dåvarande Folkhälsoinstitutet och forskare från Lunds universitet genomfördes 2008-2009 en befolkningsundersökning av svenska folkets alkohol- och narkotikavanor. En enkätundersökning skickades ut till 58000 individer med övervikt av vissa grupper, som antogs ha en lägre sannolikhet att besvara enkäten och en högre sannolikhet att ha en överkonsumtion av alkohol eller narkotika (män, yngre personer och personer boende i storstäderna). Enkäten besvarades av 22095 individer, vilket ger en svarsfrekvens på 38 procent (52 procent när man tagit hänsyn till den ovan beskrivna överrepresentationen av vissa grupper). I artikeln studeras två frågeställningar: *hur skiljer sig cannabisanvändare från dem som inte använder cannabis* och *hur skiljer sig de som använder cannabis ofta från dem som använder cannabis mindre ofta*? De som hade använt cannabis under det senaste året hade oftare en riskkonsumtion av alkohol och använde oftare narkotika samt narkotikaklassade läkemedel oftare än dem som inte använde cannabis. Cannabisanvändning var också vanligare bland män, individer under 35 år, ensamstående, arbetslösa, låginkomsttagare och högutbildade. I den grupp som använde cannabis det senaste året skiljde vi mellan

frekventa användare, dvs. de som använder cannabis 2-3 gånger per vecka eller mer ofta, och *mindre frekventa* användare, dvs. de som använder cannabis högst en gång per vecka. Frekventa cannabisanvändare tillhörde oftare den äldre åldersgruppen än de mindre frekventa användarna, och de var också oftare låginkomsttagare och arbetslösa. De frekventa cannabisanvändarna använde oftare andra illegala droger, men var mindre ofta riskkonsumenter av alkohol. En möjlig tolkning av deras lägre riskbruk kan vara att de individer som går vidare från ett sporadiskt cannabisbruk till ett mer regelbundet bruk tenderar att minska sin alkoholkonsumtion väsentligt. En annan möjlighet är att det finns olika grupper av sporadiska cannabisanvändare, och att den grupp som inte ägnar sig åt riskdrickande löper större risk att öka sitt cannabisbruk, så att detta blir mer regelbundet.

Arbete 2

Detta arbete utgår från ett datamaterial från en studie av ca 1400 ungdomar och deras föräldrar. I studien ingick 21 högstadieskolor i Sverige och syftet var att utvärdera effekten av evidensbaserade förebyggande insatser för bland annat alkohol- och narkotikaanvändning. Eleverna och deras föräldrar följdes från början av sjunde till slutet av nionde klass, och de fick under denna tid besvara ett flertal enkäter. I detta arbete var vi intresserade av att undersöka hur mycket föräldrar vet om sina barns tobaks-, alkohol- och drogvanor, och vilka faktorer som hänger samman med föräldrarnas kunskap i denna fråga. Vi jämförde elevernas och föräldrarnas svar rörande användning av dessa substanser och fann att föräldrarna vet väldigt lite om sina ungdomars erfarenheter av tobak, alkohol och narkotika. En av de faktorer som var tydligast kopplade till föräldrarnas kunskap var vilken årskurs eleverna gick i. Som exempel visste endast fem procent av föräldrarna om att deras barn i årskurs sju hade varit berusade av alkohol, jämfört med tjugosex procent i årskurs nio. Tjugoen procent av föräldrarna kände till att deras barn hade rökt cigaretter i årskurs nio, och endast fem procent att de hade använt narkotika. Föräldrarna visste mer om pojkars alkoholvanor, och ju oftare ungdomarna använde alkohol eller cigaretter, desto högre var sannolikheten att föräldrarna kände till detta. Resultaten i denna studie visar att svenska föräldrar till barn i högstadieåldern har mycket dålig kännedom om sina barns erfarenheter av tobak, alkohol och narkotika. En litteraturgenomgång av liknande studier som gjorts i andra länder visar att svenska föräldrar tycks vara mer ovetande om detta än föräldrar i många andra länder.

Arbete 3

Det datamaterial som låg till grund för arbete 2 har också använts i detta arbete. I detta arbete var vi intresserade av att studera vilka faktorer som påverkade

92

elevernas risk att börja röka regelbundet, börja med berusningsdrickande och börja använda narkotika under högstadiet. Vi var särskilt intresserade av att ta reda på vilket inflytande föräldrarna hade. Föräldraskapsstil brukar delas in i fyra olika huvudtyper. *Auktoritativa* föräldrar är närvarande och varma, men ställer också krav på ansvarsfullt beteende i förhållande till barnets mognadsgrad. *Auktoritära* föräldrar fokuserar på regler och krav, och kan vara emotionellt frånkopplade och inte så delaktiga i sina barns liv. *Tillåtande* föräldrar kan sägas vara de auktoritära föräldrarnas motsats. De är närvarande, delaktiga och känslomässigt starkt knutna till sina barn, men är dåliga på att sätta gränser för och ställa krav på sina barn. *Försumliga* föräldrar är varken emotionellt närvarande eller är så intresserade av sina barns uppfostran. Barnen lämnas att göra som de vill utan gränser eller känslomässigt stöd från sina föräldrar. Tidigare studier har visat att den *auktoritativa* föräldraskapsstilen skyddar bäst mot att barnen ska börja med tobak, alkohol eller narkotika, men få tidigare studier har studerat detta över tid. Vi fann att föräldraskapsstilen, när man tagit hänsyn till andra faktorer som exempelvis normbrytande beteenden och att ha vänner som ägnar sig åt normbrytande beteenden, hade en mycket liten påverkan på elevernas benägenhet att börja använda olika substanser. Ett undantag var att den auktoritära föräldraskapsstilen faktiskt verkar något skyddande mot ett mer frekvent berusningsdrickande och möjligen även mot vanerökning. Andra aspekter av föräldraskapet tycktes ha större betydelse i detta avseende, särskilt om föräldrarna bjöd ungdomarna på alkohol eller inte och om föräldrarna var dagligrökare.

Sammantaget visar denna studie att föräldraskapsstilen inte tycks ha någon större betydelse för svenska ungdomars val att börja använda tobak, alkohol eller narkotika, även om den auktoritära föräldraskapsstilen i viss mån kan vara skyddande.

Arbete 4

I avhandlingens fjärde arbete användes ett datamaterial från en internationell studie om ungdomars och vuxnas erfarenheter av alkohol, narkotika och narkotikaklassade läkemedel. Studien inkluderade individer mellan 12-49 år från flera europeiska länder. Läkemedelsföretaget Shire finansierade studien, och studien designades och genomfördes av forskningsinstitutet RTI International. Shire hade ingen delaktighet i utformningen av studien, av bearbetningen av datamaterialen eller i publikationen av studien. Vi använde en delmängd av detta material bestående av nästan 2000 unga vuxna, 18-30 år, från Sverige och Danmark. De individer som ingår i detta arbete var rekryterade från de tre storstadsområdena i respektive land, och de fick besvara elektroniska enkätundersökningar. Studiedeltagarna uppgav information om riskbeteenden under tonårstiden. Vi var framför allt intresserade av hur åldern vid alkohol- och narkotikadebut och också annat normbrytande beteende under tonårstiden hänger

samman med pågående användning av tobak, regelbundet berusningsdrickande och narkotikaanvändning bland unga vuxna. Vi undersökte också hur nuvarande självskattad psykisk ohälsa, arbetslöshet och andra faktorer hängde samman med aktuell substansanvändning.

Vi fann att riskbeteenden under tonåren på ett förväntat sätt hade samband med nuvarande rökning och narkotikaanvändning. Berusningsdrickande bland unga vuxna hade inget samband med tidig alkohol- eller narkotikadebut, och de som uppgav annat normbrytande beteende under tonårstiden uppgav till och med lägre nivåer av berusningsdrickande än genomsnittet. Nuvarande narkotikaanvändning var starkt kopplat till tidig narkotikadebut. Denna tendens var mycket mer uttalad hos svenskar än hos danskar. Detta kan tala för att narkotikaanvändning, både i tonåren och i vuxen ålder, i mindre grad utgör ett normbrytande beteende i Danmark än i Sverige, då fler danskar än svenskar använder narkotika. Sammantaget bekräftar denna studie sambanden mellan tidiga normbrytande beteenden och konsumtionsmönster av substanser hos unga vuxna, men detta tycks inte gälla berusningsdrickande.

Summering och betydelse

Riskabelt substansbruk debuterar ofta i tonåren och kan utvecklas till beroende i tidig vuxen ålder. Betydelsen av välkända riskfaktorer för substansbruk bekräftas i två av studierna i denna avhandling. De två andra studierna i avhandlingen belyser specifikt föräldrarnas roll i ungdomars substansanvändning, och visar att föräldrarna vet mycket mindre än de tror om detta, och att deras föräldrastil inte heller har särskilt stor makt att påverka sina barn. Föräldrarna tycks däremot ha en viss möjlighet att påverka sina barn, dels genom sitt eget förhållningssätt till alkohol och tobak, dels genom att låta bli att bjuda ungdomarna på alkohol. Slutligen visas att cannabisanvändare, en grupp som huvudsakligen utgörs av ungdomar och unga vuxna, inte är en homogen grupp, utan att det kan finnas distinkta subgrupper som kan ha olika mönster av riskbeteende. Substansanvändning i tonåren och bland unga vuxna har stor betydelse för framtida utveckling av problem relaterade till missbruk och beroende. De resultat som presenteras i denna avhandling belyser viktiga aspekter av substansanvändning hos ungdomar och unga vuxna, och kan användas för att utveckla av förebyggande åtgärder.

References

Adalbjarnardottir, S. and Hafsteinsson, L.G. (2001). Adolescents' Perceived Parenting Styles and Their Substance Use: Concurrent and Longitudinal Analyses. Journal of Research on Adolescence 11(4): 401-423.

Adams, G., Berzonsky, M. (2005). Blackwell handbook of adolescence, Wiley-Blackwell.

Allen, M., Donohue, W.A., Griffin, A., Ryan, D. Turner, M.M.M. (2003). Comparing the influence of parents and peers on the choice to use drugs: A meta-analytic summary of the literature. Criminal Justice and Behavior 30(2): 163-186.

Andréasson, S., Danielsson, A.K., Hallgren, M. (2013). Severity of alcohol dependence in the Swedish adult population: association with consumption and social factors. Alcohol 47(1): 21-25.

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders: Fifth Edition. Arlington, VA, APA Press.

Baer, J. S., Sampson, P.D., Barr, H.M., Connor, P.D., Streissguth, A.P. (2003). A 21-year longitudinal analysis of the effects of prenatal alcohol exposure on young adult drinking. Archives of General Psychiatry 60(4): 377-385.

Bahr, S. J., Marcos, A.C., Maughan, S.L. (1995). Family, educational and peer influences on the alcohol use of female and male adolescents. Journal of Studies on Alcohol 56(4): 457-469.

Barkley, R. A. (2006). Attention-deficit/hyperactivity disorder: A handbook for diagnosis and treatment (3rd ed.). New York, Guilford Press.

Barnes, G. M., Reifman, A.S., Farrell, M.P., Dintcheff, B.A. (2000). The effects of parenting on the development of adolescent alcohol misuse: A six-wave latent growth model. Journal of Marriage and Family 62(1): 175-186.

Barnow, S., Schultz, G., Lucht, M., Ulrich, I., Preuss, U.W., Freyberger, H.J. (2004). Do alcohol expectancies and peer delinquency/substance use mediate the relationship between impulsivity and drinking behaviour in adolescence? Alcohol 39(3): 213-219.

Baumrind, D. (1967). Child care practices anteceding three patterns of preschool behavior. Genetic psychology monographs 75(1): 43-88.

Baumrind, D. (1971). Current patterns of parental authority. Developmental Psychology Vol 4 (1, part 2): 1-103.

Becoña, E., Martínez, U., Calafat, A., Juan, M., Fernández-Hermida, J.R., Secades-Villa, R. (2012). Parental styles and drug use: A review. Drugs: Education, Prevention and Policy 19(1): 1-10.

Bergman, H., Kallmen, H. (2002). Alcohol use among Swedes and a psychometric evaluation of the alcohol use disorders identification test. Alcohol 37(3): 245-251.

Berner, M. M., Kriston, L., Bentele, M. Harter, M. (2007). The alcohol use disorders identification test for detecting at-risk drinking: a systematic review and meta-analysis. Journal of Studies on Alcohol and Drugs 68(3): 461-473.

Branstetter, S. A., Low, S., Furman, W. (2011). The Influence of Parents and Friends on Adolescent Substance Use: A Multidimensional Approach. Journal of Substance Use 16(2): 150-160.

Bränström R, Andréasson. S. (2008). Regional differences in alcohol consumption, alcohol addiction and drug use among Swedish adults. Scand J Public Health 36(5): 493-503.

Čablová, L., Pazderková, K., Miovský, M. (2014). Parenting styles and alcohol use among children and adolescents: A systematic review. Drugs: Education, Prevention and Policy 21(1): 1-13.

Chang, F. Lee, C., Miao, N., Lin, S., Lee, S., Lung, C., & Liao, H. (2013). Parent–Adolescent discrepancies in reports of adolescent tobacco and alcohol use associated with family relationships in Taiwan. Journal of Substance Use 18: 288-301.

Chassin, L., Pitts, S.C., DeLucia, C. (1999). The relation of adolescent substance use to young adult autonomy, positive activity involvement, and perceived competence. Development and Psychopathology 11(4): 915-932.

Chassin, L., Presson, C.C., Pitts, S.C., Sherman, S.J. (2000). The natural history of cigarette smoking from adolescence to adulthood in a midwestern community sample: multiple trajectories and their psychosocial correlates. Health Psychology 19(3): 223-231.

Chassin, L., Presson, C.C., Rose, J., Sherman, S.J., Davis, M.J., Gonzalez, J.L. (2005). Parenting style and smoking-specific parenting practices as predictors of adolescent smoking onset. Journal of Pediatric Psychology 30(4): 333-344.

Chatterji, P. (2006). Does alcohol use during high school affect educational attainment?: Evidence from the National Education Longitudinal Study. Economcis of Education Review 25: 482-497.

Chen, C. Y., Storr, C.L., and Anthony, J.C. (2009). Early-onset drug use and risk for drug dependence problems. Addictive Behaviors 34(3): 319-322.

Chilcoat, H.D., Anthony, J.C. (1996). Impact of parent monitoring on initiation of drug use through late childhood. Journal of the American Academy of Child and Adolescent Psychiatry 35(1): 91-100.

Coffey, C., Lynskey, M., Wolfe, R. Patton, G.C. (2000). Initiation and progression of cannabis use in a population-based Australian adolescent longitudinal study. Addiction 95(11): 1679-1690.

Collett, D. (2014). Modelling Survival Data in Medical Research, Third Edition, Chapman and Hall/CRC.

Comasco, E., Nordquist, N., Leppert, J., Oreland, L., Kronstrand, R., Alling, C., Nilsson, K.W. (2009). Adolescent alcohol consumption: biomarkers PEth and FAEE in relation to interview and questionnaire data. Journal of Studies on Alcohol and Drugs 70(5): 797.

Daniel, J. Z., Hickman, M., Macleod, J., Wiles, N., Lingford-Hughes, A., Farrell, M., Araya, M., Skapinakis, P., Haynes, J., Lewis, G. (2009). Is socioeconomic status in early life associated with drug use? A systematic review of the evidence. Drug and Alcohol Review 28(2): 142-153.

Danish Health and Medicines Authority (2013). Narkotikasituationen i Denmark 2013. Copenhagen, Danish Health and Medicines Authority.

Danish Health and Medicines Authority (2015). Faktaark om undersøgelsen af danskernes rygevaner 2014. Copenhagen, Danish Health and Medicines Authority.

Dawson, D.A. (2011). Defining risk drinking. Alcohol Research & Health 34(2): 144-156.

Degenhardt, L., Chiu, W.T., Sampson, N., et al. (2007). Epidemiological patterns of extra-medical drug use in the United States: Evidence from the National Comorbidity Survey Replication 2001–2003. Drug and Alcohol Dependence 90(2-3): 210-223.

Degenhardt, L., Dierker, L., Chiu, W.T., et al. (2010). Evaluating the drug use "gateway" theory using cross-national data: consistency and associations of the order of initiation of drug use among participants in the WHO World Mental Health Surveys. Drug and Alcohol Dependence 108(1-2): 84-97.

Degenhardt, L., O'Loughlin, C., Swift, W., Romaniuk, H., Carlin, J., Coffey, C., Hall, W. Patton, G. (2013). The persistence of adolescent binge drinking into adulthood: findings from a 15-year prospective cohort study. BMJ Open 3(8): e003015.

Delaney-Black, V., Chiodo L.M., Hannigan, J.H., Greenwald, M.K., Janisse, J., Patterson, G., Huestis, M.A., Ager, J. and Sokol, R.J. (2010). Just say "I don't": lack of concordance between teen report and biological measures of drug use. Pediatrics 126(5): 887-893.

DeWit, D.J., Adlaf, E.M., Offord, D.R., and Ogborne, A.C. (2000). Age at first alcohol use: a risk factor for the development of alcohol disorders. American Journal of Psychiatry 157(5): 745-750.

DeWit, D. J, Hance, J., Offord, D.R, Ogborne, A. (2000). The influence of early and frequent use of marijuana on the risk of desistance and of progression to marijuana-related harm. Preventive Medicine 31(5): 455-464.

Edwards, A. C., Kendler, K.S. (2012). Twin study of the relationship between adolescent attention-deficit/hyperactivity disorder and adult alcohol dependence. Journal of Studies on Alcohol and Drugs 73(2): 185-194.

Ellickson, P.L., Tucker, J. S., Klein, D.J. (2003). Ten-year prospective study of public health problems associated with early drinking. Pediatrics 111(5 Pt 1): 949-955.

Ellickson, P. L., Tucker, J.S, Klein, D.J., Saner, H. (2004). Antecedents and outcomes of marijuana use initiation during adolescence. Preventive Medicine 39(5): 976-984.

EMCDDA (2015). European Drug Report: Trends and Development. European Monitoring Centre for Drugs and Drug Addiction. Luxembourg, Publications Office of the European Union.

Engels, R.C., Van der Vorst, H., Dekovic M., Meeus, W. (2007). Correspondence in collateral and self-reports on alcohol consumption: a within family analysis. Addictive Behaviors 32(5): 1016-1030.

Englund, M. M., Siebenbruner, J., Oliva, E.M. Egeland, B., Chung, C.T., Long, J.D. (2013). The developmental significance of late adolescent substance use for early adult functioning. Developmental Psychology 49(8): 1554-1564.

Fenton, M. C., Keyes, K., Geier, T., Greenstein, E., Skodol, A., Krueger, B, Grant, B.F., Hasin, D. (2012). Psychiatric comorbidity and the persistence of drug use disorders in the United States. Addiction 107(3): 599-609.

Fergusson, D. M., Boden, J.M. (2008). Cannabis use and later life outcomes. Addiction 103(6): 969-976; discussion 977-968.

Ferrer-Wreder, L., Sundell, K., Eichas, K., & Habbi, M., Beheshti, S. (2015). An empirical test of a diffusion framework for school-based prevention: the 21 Swedish junior high school study. Journal of Community Psychology 43(7): 811-831.

Fischer, B., Rehm, J., Irving, H., Ialomiteanu, A., Fallu, J., Patra, J. (2010). Typologies of cannabis users and associated characteristics relevant for public health: a latent class analysis of data from a nationally representative Canadian adult survey. International Journal of Methods in Psychiatric Research 19(2): 110-124.

Flory, K., Lynam, D.R. (2003). The relation between attention deficit hyperactivity disorder and substance abuse: what role does conduct disorder play? Clinical Child and Family Psychology Review 6(1): 1-16.

Foley, K. L., Altman, D., Durant, R.H., Wolfson, M. (2004). Adults' approval and adolescents' alcohol use. Journal of Adolescent Health 35(4): 345.e317-326.

Forouzanfar, M. H. et al. (2015). Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. S0140-6736(15)00128-2. Epub ahead of print.

Fosco, G. M., Stormshak, E.A, Dishion, T.J, and Winter, C.E. (2012). Family relationships and parental monitoring during middle school as predictors of early adolescent problem behavior. Journal of Clinical Child & Adolescent Psychology 41(2): 202-213.

Freitag, C. M., Rohde, L.A., Lempp, T., Romanos, M. (2010). Phenotypic and measurement influences on heritability estimates in childhood ADHD. European Child & Adolescent Psychiatry 19(3): 311-323.

Furukawa, T. A., Kessler, R.C., Slade, T., Andrews, G. (2003). The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. Psychological Medicine 33(2): 357-362.

Gelman, A. (2007). Data Analysis Using Regression and Multilevel/Hierarchical Models (Analytical Methods for Social Research), Cambridge University Press.

Grant, B. F. (1998). Age at smoking onset and its association with alcohol consumption and DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. Journal of Substance Abuse 10(1): 59-73.

Grant, B. F., Dawson, D.A. (1997). Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. Journal of Substance Abuse 9: 103-110.

Grant, B. F., Dawson, D.A. (1998). Age of onset of drug use and its association with DSM-IV drug abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. Journal of Substance Abuse 10(2): 163-173.

Greenberg, M. T. Lippold, M.A. (2013). Promoting healthy outcomes among youth with multiple risks: innovative approaches. Annual Review of Public Health 34: 253-270.

Guignard, R., Wilquin, J.L., Richard, J.B., Beck, F. (2013). Tobacco smoking surveillance: is quota sampling an efficient tool for monitoring national trends? A comparison with a random cross-sectional survey. PLoS One 8(10): e78372.

Guilamo-Ramos, V., Jaccard, J., Turrisi, R., Johansson, M., Bouris, A. (2006). Maternal perceptions of alcohol use by adolescents who drink alcohol. Journal of Studies on Alcohol 67(5): 730-737.

Gunter, T. D., Vaughn, M.G., Philibert, R.A. (2010). Behavioral genetics in antisocial spectrum disorders and psychopathy: a review of the recent literature. Behavioral Sciences & the Law 28(2): 148-173.

Guo, J., Hawkins, J.D., Hill, K.G., Abbott, R.D. (2001). Childhood and adolescent predictors of alcohol abuse and dependence in young adulthood. Journal of Studies on Alcohol 62(6): 754-762.

Hale, D. R., Fitzgerald-Yau, N., Viner, R.M. (2014). A systematic review of effective interventions for reducing multiple health risk behaviors in adolescence. American Journal of Public Health 104(5): e19-41.

Hall, W. (2009). The adverse health effects of cannabis use: What are they, and what are their implications for policy? International Journal of Drug Policy 20(6): 458-466.

Hall, W., Pacula, R. (2003). Cannabis Use and Dependence: Public Health and Public Policy, Cambridge University Press.

Haro, J. M., Arbabzadeh-Bouchez, S., Brugha, T.S., de Girolamo, G., Guyer, M.E., Jin, R., Lepine, J.P., Mazzi, F., Reneses, B., Vilagut, G., Sampson, N.A., Kessler, R.C. (2006). Concordance of the Composite International Diagnostic Interview Version 3.0 (CIDI 3.0) with standardized clinical assessments in the WHO World Mental Health surveys. International Journal of Methods in Psychiatric Research 15(4): 167-180.

Hawkins, J. D., Catalano, R.F., Miller, J.Y., (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention. Psychological Bulletin 112(1): 64-105.

Hayatbakhsh, M. R., Najman, J.M., Bor, W., Clavarino, A., Alati, R. (2011). School performance and alcohol use problems in early adulthood: a longitudinal study. Alcohol 45(7): 701-709.

Henriksson, C., Ramstedt, M. (2015). Tobaksvanor i Sverige. Stockholm, Swedish Council for Information on Alcohol and Other Drugs (CAN).

Hibell, B., Guttormsson, U., Ahlström, S., Balakireva, O., Bjarnason, T., Kokkevi, A., Kraus, L (2009). The 2007 ESPAD report: Substance Use Among Students in 35 European Countries. European Monitoring Centre for Drugs and Drug Addiction. Stockholm, The Swedish Council for Information on Alcohol and Other Drugs (CAN).

Hibell, B., Guttormsson, U., Ahlström, S., Balakireva, O., Bjarnason, T., Kokkevi, A., Kraus, L (2012). The 2011 ESPAD report: Substance use among students in 36 European countries. European Monitoring Centre for Drugs and Drug Addiction. Stockholm, Sweden, The Swedish Council for Information on Alcohol and Other Drugs.

Hill, S. Y., Shen, S., Lowers, L., Locke, J. (2000). Factors predicting the onset of adolescent drinking in families at high risk for developing alcoholism. Biological Psychiatry 48(4): 265-275.

Hofvander, B., Ossowski, D., Lundström, S., Anckarsäter, H. (2009). Continuity of aggressive antisocial behavior from childhood to adulthood: The question of phenotype definition. International Journal of Law and Psychiatry 32(4): 224-234.

Holmes, S. E., Slaughter, J.R., Kashani, J. (2001). Risk factors in childhood that lead to the development of conduct disorder and antisocial personality disorder. Child Psychiatry & Human Development 31(3): 183-193.

Hu, M.C., Davies, M., Kandel, D.B. (2006). Epidemiology and correlates of daily smoking and nicotine dependence among young adults in the United States. American Journal of Public Health 96(2): 299-308.

IBM Corp. (2011). IBM SPSS Statistics for Windows. Version 20. Armonk, NY: IBM Corp.

IBM Corp. (2013). IBM SPSS Statistics for Windows. Version 22. Armonk, NY: IBM Corp.

Im, E.O., Chee, W. (2011). Quota sampling in internet research: practical issues. Computers Informatics Nursing 29(7): 381-385.

Jackson, C., Geddes, R., Haw, S., J. Frank, J. (2012). Interventions to prevent substance use and risky sexual behaviour in young people: a systematic review. Addiction 107(4): 733-747.

Jackson, C., Henriksen, L., Dickinson, D. (1999). Alcohol-specific socialization, parenting behaviors and alcohol use by children. Journal of Studies on Alcohol 60(3): 362-367.

Johnston, L. D., O'Malley, P. M., Miech, R. A., Bachman, J. G., & Schulenberg, J. E. (2015). Monitoring the Future national survey results on drug use: 1975-2014: Overview, key findings on adolescent drug use. The University of Michigan. Institute for Social Research. Ann Arbor, National Institute on Drug Abuse.

Jungerman FS, Menezes, P.R., Pinsky I, et al (2010). Prevalence of cannabis use in Brazil: Data from the I Brazilian National Alcohol Survey (BNAS). Addictive Behaviors 35(3): 190-193.

Kandel, D. B. (1985). On processes of peer influences in adolescent drug use: A development perspective. Advances in Alcohol and Substance Abuse 4(3-4): 139-163.

Kendler, K. S., Heath, A.C., Neale, M.C., Kessler, R.C., Eaves, L. J. (1992). A population-based twin study of alcoholism in women. JAMA 268(14): 1877-1882.

Kessler, R. C., Barker, P.R., Colpe, L.J., Epstein, J.F., Gfroerer, J.C., Hiripi, E., Howes, M.J., Normand, S.L., Manderscheid, R.W., Walters, E.E., Zaslavsky, A.M. (2003). Screening for serious mental illness in the general population. Archives of General Psychiatry 60(2): 184-189.

Kessler, R. C., Ustun, T.B. (2004). The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). International Journal of Methods in Psychiatric Research 13(2): 93-121.

Kestila, L., Martelin, T., Rahkonen, O., Joutsenniemi, K., Pirkola, S., Poikolainen, K., Koskinen, S. (2008). Childhood and current determinants of heavy drinking in early adulthood. Alcohol 43(4): 460-469.

Kosterman, R., Hawkins, J.D., Guo, J., Catalano, R.F., Abbott, R.D. (2000). The dynamics of alcohol and marijuana initiation: patterns and predictors of first use in adolescence. American Journal of Public Health 90(3): 360-366.

Körner, S., Wahlgren, L. (2012). Praktisk Statistik. Lund, Studentlitteratur AB.

Lamborn, S. D., Mounts, N.S., Steinberg, L., Dornbusch, S.M. (1991). Patterns of competence and adjustment among adolescents from authoritative, authoritarian, indulgent, and neglectful families. Child Development 62(5): 1049-1065.

Langhinrichsen, J., Lichtenstein. E., Seeley, J., Hops, H., Ary, D., Tildesley, E., Andrews, J. (1990). Parent-Adolescent Congruence for Adolescent Substance Use. Journal of Youth and Adolescence 19(6): 623-635.

Latendresse, S. J., Rose, R. J. Viken, R.J., Pulkkinen, L., Kaprio, J., Dick, D.M. (2009). Parental socialization and adolescents' alcohol use behaviors: Predictive disparities in parents' versus adolescents' perceptions of the parenting environment. Journal of Clinical Child and Adolescent Psychology 38(2): 232-244.

Latvala, A., Rose, R.J., Pulkkinen, L., Dick, D.M., Korhonen, T., Kaprio, J. (2014). Drinking, smoking, and educational achievement: cross-lagged associations from adolescence to adulthood. Drug and Alcohol Dependence 137: 106-113.

Lawrence, D., Fagan, P., Backinger, C.L., Gibson, J.T., Hartman, A. (2007). Cigarette smoking patterns among young adults aged 18-24 years in the United States. Nicotine & Tobacco Research 9(6): 687-697.

Lee, S. S., Humphreys, K.L., Flory, K., Liu, R., K. Glass, K. (2011). Prospective association of childhood attention-deficit/hyperactivity disorder (ADHD) and substance use and abuse/dependence: a meta-analytic review. Clinical Psychology Review 31(3): 328-341.

Lippold, M. A., Coffman, D.L., Greenberg, M.T. (2014). Investigating the potential causal relationship between parental knowledge and youth risky behavior: a propensity score analysis. Prevention Science 15(6): 869-878.

Little, R. (1993). Post-Stratification: A Modeler's Perspective. Journal of the American Statistical Association 88(423): 1001-1012.

Loeber, R., Burke, J.D., Lahey, B.B., Winters, A., Zera, M. (2000). Oppositional defiant and conduct disorder: a review of the past 10 years, part I. Journal of the American Academy of Child and Adolescent Psychiatry 39(12): 1468-1484.

Lumley, T. (2004). Analysis of complex survey samples. Journal of Statistical Software 9(1): 1-19.

Lumley, T. (2014). Survey: analysis of complex survey samples. R package version 3.30.

Maccoby, E., Martin, JA. (1983). Socialization in the context of the family: Parent-child interaction. Handbook of child psychology. P. H. Mussen. New York, Wiley. 4: 1-101.

Marschall-Levesque, S., N. Castellanos-Ryan, F. Vitaro and J. R. Seguin (2014). Moderators of the association between peer and target adolescent substance use. Addictive Behaviors 39(1): 48-70.

McGee, R., Williams, S., Poulton, R., Moffitt, T. (2000). A longitudinal study of cannabis use and mental health from adolescence to early adulthood. Addiction 95(4): 491-503.

McMorris, B. J., Catalano, R.F., Kim, M.J., Toumbourou, J.W., Hemphill, S.A. (2011). Influence of family factors and supervised alcohol use on adolescent alcohol use and harms: similarities between youth in different alcohol policy contexts. Journal of Studies on Alcohol and Drugs 72(3): 418-428.

Meyers, J. L., Dick, D.M. (2010). Genetic and environmental risk factors for adolescent-onset substance use disorders. Child & Adolescent Psychiatric Clinics of North America 19(3): 465-477.

Miller, P., Plant, M. (1999). Truancy and perceived school performance: an alcohol and drug study of UK teenagers. Alcohol 34(6): 886-893.

Miller, P., Plant, M. (2002). Heavy cannabis use among UK teenagers: an exploration. Drug and Alcohol Dependence 65(3): 235-242.

Morrow, K. M., S. Vargas, S., Rosen, R.K., Christensen, A.L. Salomon, L. Shulman, L., Barroso, C., Fava, J.L. (2007). The utility of non-proportional quota sampling for recruiting at-risk women for microbicide research. AIDS and Behavior 11(4): 586-595.

Murray, J., Farrington, D.P. (2010). Risk factors for conduct disorder and delinquency: key findings from longitudinal studies. Canadian Journal of Psychiatry 55(10): 633-642.

Nash, S. G., McQueen, A., Bray, J.H. (2005). Pathways to adolescent alcohol use: family environment, peer influence, and parental expectations. Journal of Adolescent Health 37(1): 19-28.

Nutt, D. J., King, A., Phillips, L.D. (2010). Drug harms in the UK: a multicriteria decision analysis. Lancet 376(9752): 1558-1565.

Organisation for Economic co-operation and Development (OECD) (2015). OECD.Stats. from http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT.

Olsson, B., Blomqvist, J., Edman, J., Göransson, B., Sahlin, I., Träskman, PO., Törnqvist, D. (2011). Narkotika: Om problem och politik. Stockholm, Nordstedts juridik.

Palmer, R. H., Knopik, V.S., Rhee, S.H., Hopfer, C.J., Corley, R.C., Young, S.E., Stallings, M.C., Hewitt, J.K. (2013). Prospective effects of adolescent indicators of behavioral disinhibition on DSM-IV alcohol, tobacco, and illicit drug dependence in young adulthood. Addictive Behaviors 38(9): 2415-2421.

Patrick, M. E., Wightman, P., Schoeni, R.F., Schulenberg, J.E. (2012). Socioeconomic status and substance use among young adults: a comparison across constructs and drugs. Journal of Studies on Alcohol and Drugs 73(5): 772-782.

Plant, M., P. Miller, P., Plant, M., Gmel, G., Kuntsche, S., Bergmark, W.K. Bloomfield, K.,Csemy, L., Ozenturk, T., Vidal, A. (2010). The social consequences of binge drinking among 24- to 32-year-olds in six European countries. Substance Use & Misuse 45(4): 528-542.

Prescott, C. A., Kendler, K.S. (1999). Genetic and environmental contributions to alcohol abuse and dependence in a population-based sample of male twins. American Journal of Psychiatry 156(1): 34-40.

Public Health Agency of Sweden (2015). Folkhälsodata: Nationella folkhälsoenkäten, nationella och regionala resultat. Public Health Agency of Sweden.

R Core Team (2015). R: A Language and Environment for Statistical Computing. Vienna, Austria, R Foundation for Statistical Computing.

Redonnet, B., Chollet, A., Fombonne, E., Bowes, L., Melchior, M. (2012). Tobacco, alcohol, cannabis and other illegal drug use among young adults: the socioeconomic context. Drug and Alcohol Dependence 121(3): 231-239.

Rehm J, Room, R., van den Brink W, et al. (2005). Problematic drug use and drug use disorders in EU countries and Norway: An overview of the epidemiology. European Neuropsychopharmacology 15(4): 389-397.

Reinert, D.F., Allen, J.P. (2002). The Alcohol Use Disorders Identification Test (AUDIT): a review of recent research. Alcoholism: Clinical and Experimental Research 26(2): 272-279.

Roxburgh, A., Hall, W., Degenhardt, L., et al. (2010). The epidemiology of cannabis use and cannabis-related harm in Australia 1993–2007. Addiction 105(6): 1071-1079.

Ryan, S. M., Jorm, A.F., Lubman, D.I. (2010). Parenting factors associated with reduced adolescent alcohol use: a systematic review of longitudinal studies. Australian & New Zealand Journal of Psychiatry 44(9): 774-783.

Sartor, C. E., Lynskey, M.T., Heath, A.C., Jacob, T., True, W. (2007). The role of childhood risk factors in initiation of alcohol use and progression to alcohol dependence. Addiction 102(2): 216-225.

Saunders, J. B., Aasland, O.G., Babor, T.F., de la Fuente, J.R., Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II. Addiction 88(6): 791-804.

Shakya, H. B., Christakis, N.A., Fowler, J.H. (2012). Parental influence on substance use in adolescent social networks. Archives of Pediatrics and Adolescent Medicine 166(12): 1132-1139.

Shucksmith, J., Glendinning and A., Hendry, L. (1997). Adolescent drinking behaviour and the role of family life: a Scottish perspective. Journal of Adolescence 20(1): 85-101.

Simons-Morton, B. (2004). Prospective association of peer influence, school engagement, drinking expectancies, and parent expectations with drinking initiation among sixth graders. Addictive Behaviors 29(2): 299-309.

Sloboda, Z., Glantz, M.D., Tarter, R.E. (2012). Revisiting the concepts of risk and protective factors for understanding the etiology and development of substance use and substance use disorders: implications for prevention. Substance Use & Misuse 47(8-9): 944-962.

Sobell, L.C., Sobell, M.B. (1996). Timeline Follow Back. User's Guide. Toronto, Addiction Research Foundation.

Solis, J. M., Shadur, J.M., Burns and A.R., Hussong, A.M. (2012). Understanding the diverse needs of children whose parents abuse substances. Current Drug Abuse Reviews 5(2): 135-147.

Spear, L.P. (2015). Adolescent alcohol exposure: Are there separable vulnerable periods within adolescence? Physiology & Behavior 148: 122-130.

SPSS Inc. (2009). PASW Statistics for Windows. Version 18. Chicago: SPSS Inc.

Stafström, M. (2014). Influence of parental alcohol-related attitudes, behavior and parenting styles on alcohol use in late and very late adolescence. European Addiction Research 20(5): 233-240.

Statistics Sweden [SCB] (2015a). Sveriges folkmängd (i ettårsklasser) 1860–2014, efter ålder och kön. Statistics Sweden.

Statistics Sweden [SCB] (2015b). [Hemmaboende barn och ungdomar 0-21 år som bor med biologiska föräldrar och styvförälder efter kön, ålder, familjetyp (sammanboende eller ensamstående föräldrar) och utländsk/svensk bakgrund. År 2000 - 2014]. Statistics Sweden.

Steinberg, L., Morris, A.S. (2001). Adolescent development. Annual Review of Psychology. 52: 83-110.

Svensson, B. (2012). Narkotikapolitik och narkotikadebat, Studentlitteratur AB.

Swedish Council for Information on Alcohol and Other Drugs [CAN] (2015). Skolelevers drogvanor 2015. Unpublished data, Swedish Council for Information on Alcohol and Other Drugs

Swedish National Institute of Public Health [FHI] (2010). Narkotikabruket i Sverge. Östersund, Swedish National Institute of Public Health.

Swift, W., Coffey, C., Degenhardt, L. (2012). Cannabis and progression to other substance use in young adults: Findings from a 13-year prospective population-based study. Journal of Epidemiology and Community Health 66(e26).

Trim, R. S., Meehan, B.T., King, K.M., Chassin, L. (2007). The relation between adolescent substance use and young adult internalizing symptoms: findings from a high-risk longitudinal sample. Psychology of Addictive Behaviors 21(1): 97-107.

van Amsterdam, J., Nutt, D., Phillips, L., van den Brink, W. (2015). European rating of drug harms. Journal of Psychopharmacology 29(6): 655-660.

van der Zwaluw, C. S., Scholte, R.H., Vermulst, A.A., Buitelaar, J.K., Verkes, R.J., Engels, R.C. (2008). Parental problem drinking, parenting, and adolescent alcohol use. Journal of Behavioral Medicine 31(3): 189-200.

Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A.J., Ferrari, A.J., Erskine, H.E., Charlson, F.J., Norman, R.E., Flaxman, A.D., Johns, N., Burstein, R., Murray, C.J., Vos, T. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. Lancet 382(9904): 1575-1586.

Williams, R. J., McDermitt, D.R., Bertrand, L.D., Davis, R.M. (2003). Parental awareness of adolescent substance use. Addictive Behaviors 28(4): 803-809.

Williams, R. J., Nowatzki, N. (2005). Validity of adolescent self-report of substance use. Substance Use & Misuse 40(3): 299-311.

Windle, M., Windle, R.C. (2012). Early onset problem behaviors and alcohol, tobacco, and other substance use disorders in young adulthood. Drug and Alcohol Dependence 121(1-2): 152-158.

World Health Organization [WHO] (2014). Global status report on alcohol and health. Noncommunicable Diseases and Mental Health. Luxembourg, World Health Organization.

World Health Organization [WHO] (2015). Global Information System on Alcohol and Health (GISAH).   Retrieved 2015-08-14.

Yang, K., Banamah, A. (2014). Quota sampling as an alternative to probability sampling? An experimental study. Sociological Research Online 19(1): 29.

Zuur, A., Ieno, E.N., Walker, N.J., Saveliev, A.A., Smith, G.M. (2009). Mixed Models and Extensions in Ecology with R, Springe

LUND UNIVERSITY
Faculty of Medicine