

TURUN YLIOPISTON JULKAISUJA  
ANNALES UNIVERSITATIS TURKUENSIS

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*SARJA - SER. D OSA - TOM. 803*

MEDICA - ODONTOLOGICA

**PREDICTORS AND CORRELATES OF  
SUBSTANCE USE AMONG YOUNG MEN**

**The Longitudinal “From a Boy to a Man”  
Birth Cohort Study**

by

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TURUN YLIOPISTO  
Turku 2008

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Cover: Turmiolan Tommin elämäkerta. Illustrated by Alexandra Frosterus-Sältin (1858).

ISBN 978-951-29-3571-0 (PRINT)

ISBN 978-951-29-3572-7 (PDF)

ISSN 0355-9483

Painosalama Oy – Turku, Finland 2008

*Happy is she who gets to know the reasons for things.*

*Felix que potuit rerum cognoscere causas.*

adapted from Vergilius (70-19 BCE)

*Everything that can be counted does not necessarily count;*

*Everything that counts cannot necessarily be counted.*

Albert Einstein (1879-1955)

Solja Niemelä

**Predictors and Correlates of Substance Use among Young Men.  
The Longitudinal “From a Boy to a Man” Birth Cohort Study.**

Department of Child Psychiatry, University of Turku, Finland.

**ABSTRACT**

Substance use is one of our most important public health problems. Studying risk factors in a longitudinal study setting helps to identify subgroups of young people at greater risk for substance-use-related problems, and to facilitate targeted prevention efforts. The aim of this thesis was to study childhood predictors and correlates of substance-use-related outcomes among young men in a longitudinal, nationwide birth cohort study.

The study population included 10% of all Finnish-speaking boys born in Finland in 1981 (n=2946, 97% of the target population). In 1989, at age eight, valid measures of psychiatric symptoms (Rutter questionnaires and Children’s Depression Inventory) were obtained from parents, teachers and the boys themselves. In 1999, at age 18, boys were reached at their obligatory military call-up (n=2348, 80% of the boys attending the study in 1989). Self-reports of substance use, psychopathology, adaptive functioning (Young Adult Self-Report), and mental health service use were obtained through questionnaires. Information about psychiatric diagnoses from the Military Register (age 18-23 years) and information about offending from the National Police Register (age 16-20 years) were collected in early adulthood (92% of the 1989 sample).

Boys with childhood conduct, hyperactive, and comorbid conduct-emotional problems had elevated rates of substance use and substance-use-related crime in early adulthood. Depressive symptoms predicted daily smoking, especially among boys of low-educated fathers. Emotional problems predicted lower occurrence of drunkenness-related alcohol use and smoking. Teacher reports on boys’ problem behaviour had the best predictive power for later substance use.

At age 18, frequent drunkenness associated with delinquency, smoking and illicit drug use, and having friends. Occasional drunkenness associated with better psychosocial functioning in general compared to boys with frequent drunkenness or without drunkenness-related alcohol use. Illicit drug use without drug offending was not predicted by childhood psychiatric symptoms, but 22% of boys with illicit drug use had a psychiatric diagnosis in early adulthood. Drug offenders, in turn, had psychiatric problems both in childhood and in adulthood. Psychiatric disorders were common among young men with substance-use-related crime. Recidivist crime associated strongly with having a substance use disorder diagnosis according to the Military Register. At age 18, frequent drunkenness was common among boys entering mental health services, but entering substance use treatment was non-existent.

According to the findings of this thesis, substance-use-related outcomes accumulate in boys having psychiatric problems both in childhood and in early adulthood. Targeted early interventions in school health care systems, particularly for boys with childhood hyperactive, conduct, and comorbid conduct-emotional problems are recommended. Psychiatric problems and risky behaviours, such as delinquency should always be assessed alongside substance use. Specialized and multidisciplinary care are required for young men who have multiple or complex needs, for instance, for young men with drug offending and recidivist crime. Integrating a substance use treatment perspective with other services where young men are encountered is emphasized.

**Keywords:** substance use, risk factor, psychopathology, crime, childhood, longitudinal birth cohort study, boys

Solja Niemelä

**Nuorten miesten päihdekäytön ennustekijät ja korrelaatit.**

**“Pojasta mieheksi” -seurantatutkimus.**

Lääketieteellinen tiedekunta, kliininen laitos, lastenpsykiatria

Turun Yliopisto

## TIIVISTELMÄ

Päihdekäyttö on yksi merkittävimmistä kansanterveydellisistä haasteistamme. Lapsuudesta varhaisaikuisuuteen ulottuvissa pitkittäistutkimuksissa voidaan tunnistaa päihdeongelmien varhaisia riskitekijöitä, mikä edesauttaa ennaltaehkäisevien toimien suunnittelua. Tämän väitöskirjatyön tavoitteena oli tutkia lapsuusiän psyykkisten oireiden sekä varhaisaikuisuuden psykososiaalisten tekijöiden yhteyksiä päihdekäyttöön ja päihderikoksiin.

Tutkimuksen kohteena oli 10% otos Suomessa vuonna 1981 syntyneistä suomenkielisistä pojista (n=2946, 97% kohdeväestöstä). Vuonna 1989 kahdeksanvuotiaiden poikien psyykkisiä oireita kartoitettiin validoiduilla kyselylomakkeilla opettajilta, vanhemmilta ja pojilta itseltään (Rutter-kysely, Children Depression Inventory). Seuranta toteutettiin vuonna 1999 armeijan kutsuntatarkastuksen yhteydessä, kun pojat olivat 18-vuotiaita (n=2348, 80% tutkimukseen vuonna 1989 osallistuneista). Päihdekäyttöä, psyykkistä vointia, toimintakykyä (Young Adult Self-Report) sekä mielenterveyspalveluiden käyttöä kartoitettiin kyselylomakkein. Tiedot psykiatrisista diagnooseista kerättiin Puolustusvoimien rekisteristä (18-23 vuotta). Tiedot rikoksista poimittiin poliisin syyterekisteristä (16-20 vuotta). Rekisteritiedot olivat saatavilla 92% vuonna 1989 tutkimukseen osallistuneista.

Tutkimuksen mukaan lapsuusiän käytösongelmat, hyperaktiivisuus, sekä samanaikaiset käytös- ja tunne-elämän ongelmat ennustivat runsasta päihteiden käyttöä ja päihderikoksia. Depressio-oireet ennustivat päivittäistä tupakointia, erityisesti matalasti koulutettujen isien pojilla. Opettajien arviot lapsen psyykkisestä oireilusta ennustivat informanteista parhaiten myöhempää päihdekäyttöä.

Antisosiaalisuus, tupakointi, huumeiden käyttö ja ystävien määrä olivat yhteydessä säännölliseen humalajuomiseen 18-vuotiaana. Satunnaisesti humalaan juovilla esiintyi vähemmän psykososiaalisia ongelmia kuin viikoittain tai ei ollenkaan humalaan juovilla. Lapsuusiän psyykinen oireilu ei ennustanut huumerikoksia ilman huumerikosmerkintää, mutta varhaisaikuisuudessa huumeidenkäyttäjistä 22% oli jokin psykiatrinen diagnoosi Puolustusvoimien rekisterin mukaan. Huumerikollisilla psyykkisiä ongelmia oli sekä lapsuudessa että varhaisaikuisuudessa. Psykiatriset häiriöt olivat yleisiä päihderikoksia tekeville. Uusintarikollisuus oli yleistä päihdehäiriödiagnoosin saaneilla. Psykiatriseen hoitoon hakeutuvien joukossa säännöllinen humalajuominen oli yleistä, mutta päihdehoitoon hakeutuminen oli erittäin harvinaista.

Väitöskirjatyön tulosten mukaan päihdekäyttö on osa jo lapsuusiässä alkanutta ongelmajatkumoa. Kouluterveydenhuollossa tulisi kehittää varhaisen puuttumisen hoitomalleja pojille, joilla esiintyy käytösongelmia, hyperaktiivisuutta tai samanaikaisia käytös- ja tunne-elämän vaikeuksia. Päihdekäyttöä, psyykkistä oireilua ja muuta riskikäyttäytymistä, kuten rikollisuutta, tulisi aina arvioida samanaikaisesti. Moniammatillista erityisosaamista tulisi kehittää nuorille miehille, joilla on laaja-alaisesti ongelmia, kuten huumerikoksia ja uusintarikollisuutta. Päihdehoidollisen näkökulman yhdistäminen muihin palveluihin, joissa kohdataan nuoria miehiä, on suositeltavaa.

**Avainsanat:** päihdekäyttö, psykopatologia, riskitekijät, syntymäkohortti, pitkittäistutkimus, pojat

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## ABBREVIATIONS

AD	Alcohol Dependence
ADHD	Attention Deficit/Hyperactivity Disorder
APA	American Psychiatric Association
APD	Antisocial Personality Disorder
AUC	Area Under the Curve
AUD	Alcohol Use Disorder
AUDIT	Alcohol Use Disorders Identification Test
CAAP	Child and Adolescent Adjustment Profile
CaD	Cannabis dependence
CAPA	Child and Adolescent Psychiatric Assessment
CBCL	Child Behaviour Checklist
CCQ	California Child Questionnaire
CD	Conduct Disorder
CDI	Child Depression Inventory
C-E	Conduct-Emotional
CESDS	Center for Epidemiological Studies-Depression Scale
CI	Confidence Interval
CIDI	Composite International Diagnostic Interview
COMT	Catechol-O-Methyltransferase
CUD	Cannabis Use Disorder
DICA-R	Diagnostic Interview for Children and Adolescents-Revised
DIS	Diagnostic Interview Schedule
DISC	Diagnostic Interview Schedule for Children
DSM	Diagnostic and Statistical Manual of Mental Disorders
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders, 3 <sup>rd</sup> version, revised
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4 <sup>th</sup> version
DUD	Drug Use Disorder
EMCDDA	European Monitoring Centre for Drugs and Drug Addiction
FHQ	Family History Questionnaire
FTQ	Fagerström Tolerance Questionnaire
GHQ-28	General Health Questionnaire
ICD	International Classification of Diseases
ICD-10	International Classification of Diseases, 10 <sup>th</sup> version
IQ	Intelligence Quotient
KID-SCID	Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Child Edition
LSD	Lysergic Acid Diethylamide
MAO-A	Monoamine Oxidase A
MCMC	Markov Chain Monte Carlo Technique
MDD	Major Depressive Disorder
MDMA	3, 4-Methylenedioxymethamphetamine
MECA	Methods for the Epidemiology of Child and Adolescent Mental disorders
MFQ	Mood and Feelings Questionnaire
MPNI	Multidimensional Peer Nomination Inventory
ND	Nicotine Dependence
NNT	Number Needed to Treat



## *Abbreviations*

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ODD	Oppositional Defiant Disorder
OR	Odds Ratio
PBQ	Preschool Behavior Questionnaire
PH	Piers-Harris Children's Self-Concept Scale
PTSD	Post Traumatic Stress Disorder
RAPI	Rutgers Alcohol Problem Index
ROC	Receiver Operating Characteristic
RYDS	Revised Yale Developmental Schedules
SADS	Schedule for Affective Disorders and Schizophrenia for School-Age Children
SAMSHA	Substance Abuse and Mental Health Services Administration
SBCL	Simmons Behavior Checklist
SCID	Structured Clinical Interview for DSM Disorders
SCL-90	Symptom Checklist
SD	Standard Deviation
SES	Socio-Economic Status
SMD	Severe Mood Dysregulation
SUD	Substance Use Disorder
STAKES	Finnish Research and Development Centre for Welfare and Health
TOCA	Teacher's Observation of Classroom Adaptation
WHO	World Health Organization
YASR	Young Adult Self-Report
YSR	Youth Self-Report

## LIST OF ORIGINAL PUBLICATIONS

- I Niemelä S, Sourander A, Poikolainen K, Helenius H, Sillanmäki L, Multimäki P, Parkkola K, Piha J, Kumpulainen K, Almqvist F, Moilanen I (2006) Childhood predictors of drunkenness in late adolescence among males. A 10-year population-based follow-up study. *Addiction* 101:512.
- II Niemelä S, Sourander A, Pilowsky DJ, Susser E, Helenius H, Kumpulainen K, Piha J, Tamminen T, Moilanen I, Almqvist F. Childhood antecedents of being a cigarette smoker in early adulthood. The Finnish “From a Boy to a Man” study. *Journal of Child Psychology and Psychiatry*. *In press*.
- III Niemelä S, Sourander A, Elonheimo H, Poikolainen K, Wu P, Helenius H, Piha J, Kumpulainen K, Moilanen I, Tamminen T, Almqvist F. What predicts illicit drug use and police-registered drug offending? Findings from the Finnish “From a Boy to a Man” birth cohort study. *Social Psychiatry and Psychiatric Epidemiology*. *In Press*. *Epub 26<sup>th</sup> Apr 2008*.
- IV Sourander A, Jensen PS, Davies M, Niemelä S, Helenius H, Multimäki P, Sillanmäki L, Kumpulainen K, Piha J, Tamminen T, Moilanen I, Almqvist F (2007) Who is at greatest risk for adverse long-term outcomes? The Finnish “From a Boy to a Man” study. *Journal of American Academy of Child and Adolescent Psychiatry* 46:148.\*
- V Niemelä S, Sourander A, Poikolainen K, Elonheimo H, Helenius H, Sillanmäki L, Multimäki P, Parkkola K (2006) Adaptive functioning, psychopathology and service use among 18-year-old adolescent boys with drunkenness-related alcohol use. *Alcohol and Alcoholism* 41:143.
- VI Elonheimo H, Niemelä S, Parkkola K, Multimäki P, Helenius H, Nuutila AM, Sourander A (2007) Police-registered offenses and psychiatric disorders among young males. The Finnish “From a Boy to a Man” birth cohort study. *Social Psychiatry and Psychiatric Epidemiology* 42:477.\*

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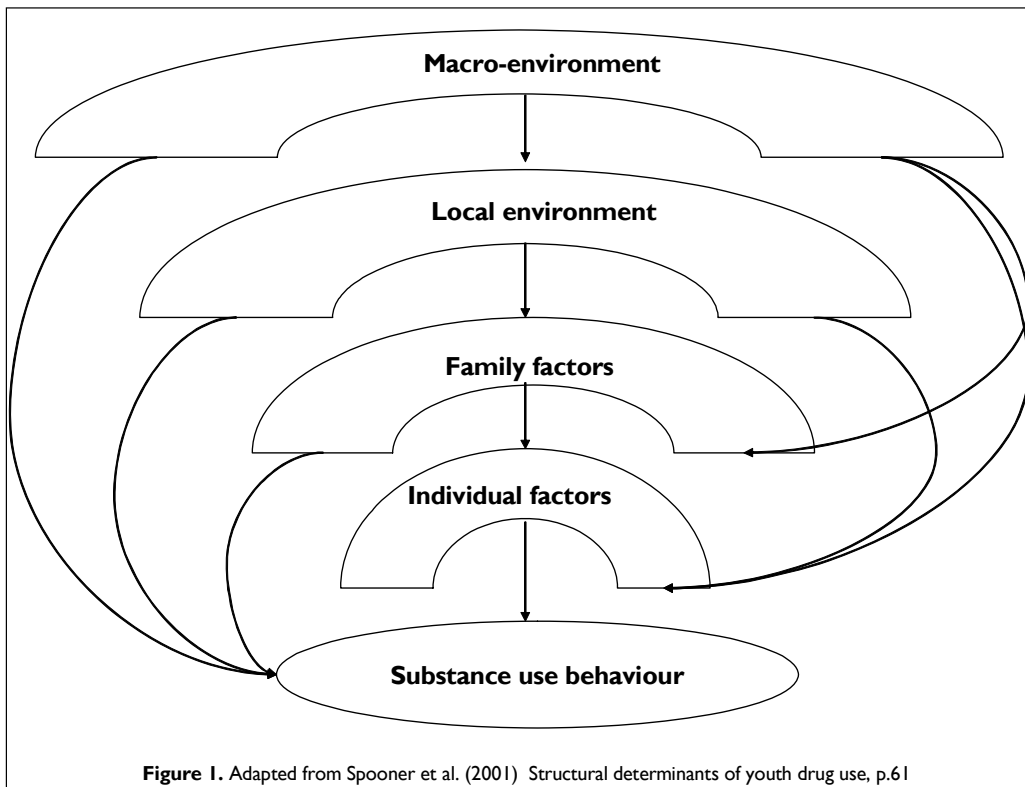
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\* Only substance-use-related outcomes in articles IV and VI are included in this thesis.

# I INTRODUCTION

In almost all cultures since the earliest times, people have used some kinds of psychoactive substances. People have taken psychoactive drugs for curative, religious and recreational purposes, and the use of substances has continued over generations. To date, substance use and misuse represent one of the most important public health problems in Western societies. In 2000, about 4% of the global burden as measured in disability adjusted life years was attributable to both alcohol and tobacco, and 0.8% to illicit drugs (Rehm et al. 2006). In 2005, alcohol-related deaths were the most common cause of death among 15-65-year-old Finnish males, accounting for 17% of total mortality among males (Statistics Finland 2007).

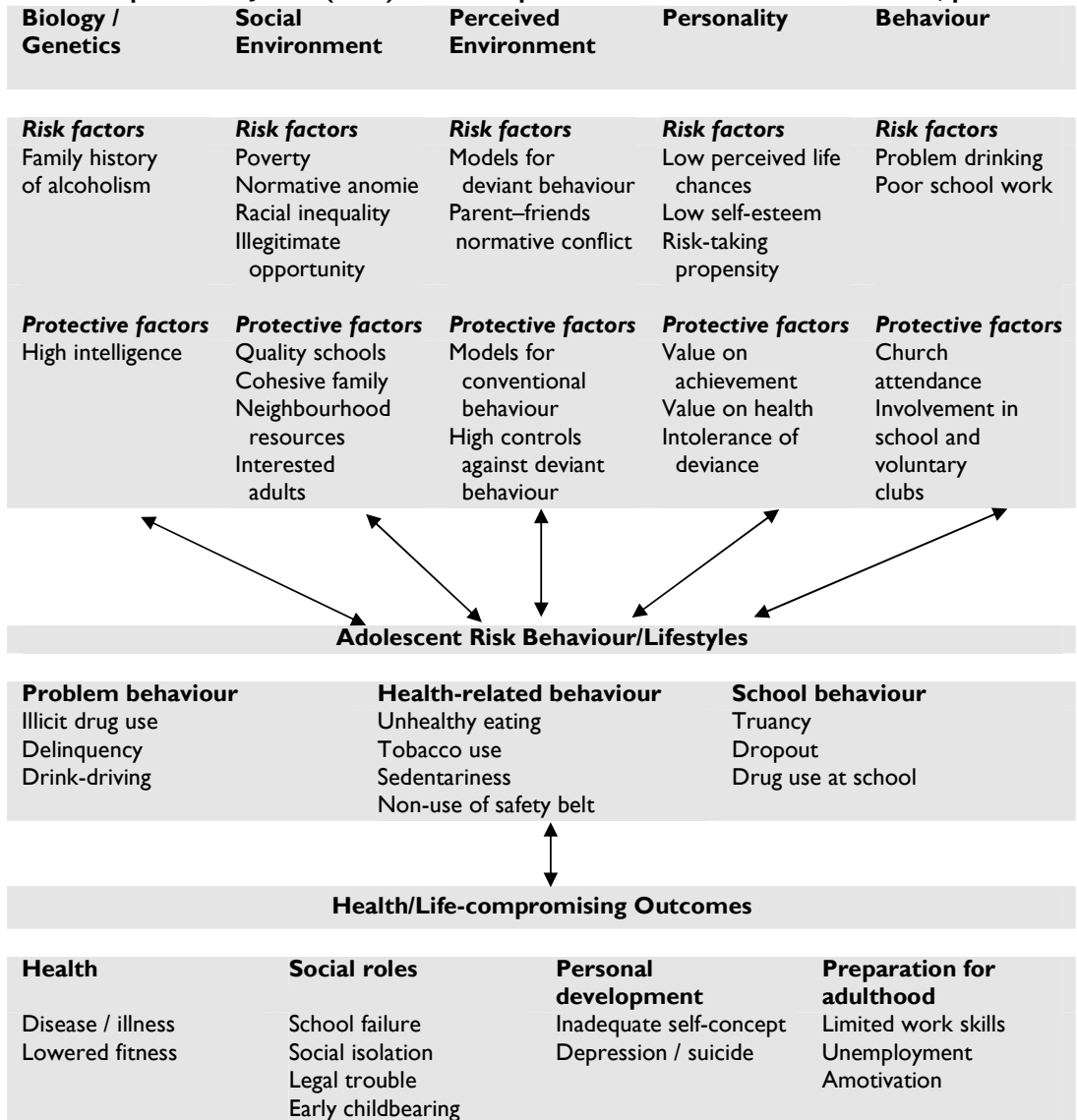
**Substance-use behaviours are a result of a complex interplay of individual and environmental factors across the life course. (Figure 1)**



In Western cultures, substance use begins typically during adolescence, peaks in early adulthood, and declines after the mid-20s (Chen and Kandel 1995). The majority of young people experimenting with or using alcohol, tobacco or illicit drugs do not progress into substance abuse or dependence or manifest substance-use-related problems in adulthood (Boden et al. 2007, Chen and Kandel 1995). However, a proportion of substance-using adolescents develop a substance use disorder (SUD) and encounter multiple substance-use-related problems, such as educational and occupational problems, interpersonal and familial conflicts, proneness to accidents, mental health problems, suicidality and criminality (Ellickson et al. 2003, Esposito-

Smythers and Spirito 2004, Maio et al. 1994). Risk factors for these different stages of involvement in substance use vary. *Jessor's Problem Behaviour Theory* suggests that there is a correlation between the various problematic behaviours in terms of risk and protective factors (**Figure 2**). Problem behaviours tend to cluster in an individual: those who experiment with substance use also tend to engage in other risky behaviours, e.g. criminality (Jessor 1991, Jessor 1998). Therefore, distinguishing young people at risk of substance-use-related problems is clinically highly important.

**Figure 2. Interrelated Conceptual Domains of Risk Factors and Protective Factors**  
**Adapted from Jessor (1998) *New Perspectives on Adolescent Risk Behavior*, p. 4.**



**Epidemiology** as a science has been defined as “an exact and basic science of social medicine and public health” (Earls 1979). *Psychiatric epidemiology* aims to recognize the public health burden of mental disorders and to explore causes of these conditions (Schwartz and Susser 2006a). *Developmental epidemiology* describes an approach to child and adolescent psychiatric epidemiology that incorporates principles of developmental psychopathology into epidemiological research. The task of developmental epidemiology is to understand the mechanisms by which developmental processes affect the risk of specific psychiatric disorders and to propose preventive strategies appropriate to the various stages of risk (Costello et al. 2006).

A generation ago, very few psychiatrists and psychologists dealing with adult mental disorders would have considered a developmental perspective as appropriate, let alone necessary (Rutter et al. 2006a). In the 1950's, O'Neil and Robins conducted a 30-year follow-up study of patients referred to child guidance and their matched group of normal controls. In their study, adult outcomes were measured comprehensively with interviews and by collecting data from police, prison, hospital, and welfare records (Robins 1966). According to their findings, delinquent children presented the worst outcomes as adults, including sociopath personalities, psychotic reactions, and alcoholism (O'Neil and Robins 1958, Robins 1966). The Isle of Wight surveys undertaken in the mid-1960s established a starting point for child psychiatric epidemiology to study causal hypotheses for childhood-onset mental disorders (Rutter 1989). At present, the value of the developmental perspective is highly recognized in epidemiological research. The task is to understand the mechanisms by which developmental processes affect the risk of specific psychiatric disorders, and to propose preventive strategies appropriate to the various stages of risk (Costello et al. 2006). The possibility of examining mediating processes has only recently emerged because of the availability of *longitudinal epidemiological studies* extending from childhood into adult life. In prospective birth cohort studies, the collection of data covers the majority of the risk period during which causal processes may accumulate. Longitudinal research also offers a possibility to identify early precursors for substance use, and to model the developmental pathways of substance use in later life.

As an adult psychiatrist, I had been working in the field of addiction psychiatry for a while before I became acquainted with research. In my clinical practice, the patients were mainly marginalized and outcast young men with intravenous illicit drug use, accompanied with a high level of psychiatric comorbidity, crime, and health problems. It was evident that many of these young men had faced multiple psychosocial problems already in childhood, before the onset of substance use. Every so often, it crossed my mind that identifying these “at risk children” might provide an opportunity to reduce the burden related to problematic substance use.

Later on, I was fortunate to have an opportunity to develop an early-intervention programme for adolescents at risk of developing substance-use-related problems. For me, this experience shifted my interest and focus from an adult psychiatric perspective into a developmental approach in understanding substance use behaviours at a young age. At the same time, perfectly fitting my increasing curiosity on the subject, adjunct professor André Sourander offered me the possibility to do my doctoral thesis in the longitudinal “From a Boy to a Man” birth cohort study. With this background, the aim of this thesis is to identify childhood risk factors and correlates of substance-use-related outcomes among young men.

## 2 REVIEW OF THE LITERATURE

### 2.1 Definitions of substance use

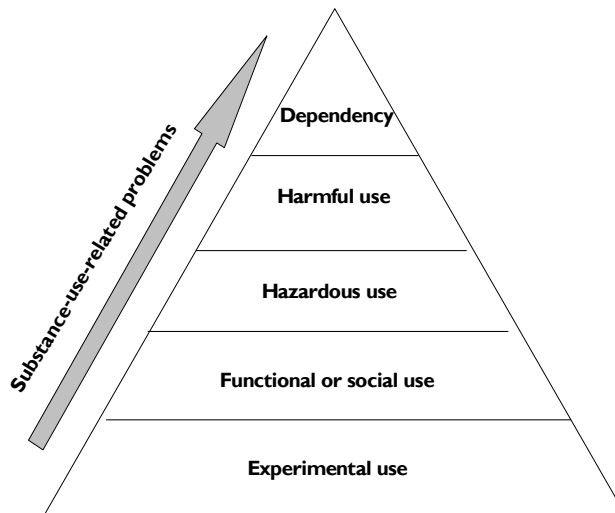
**Psychoactive substances** are substances that, when taken in or administered into one's system, affect mental processes, e.g. cognition or affect. This term and its equivalent, psychotropic drug, are the most neutral and descriptive terms for the whole class of substances, licit and illicit, of interest to drug policy. 'Psychoactive' does not necessarily imply dependence-producing, and in common parlance, the term is often left unstated, as in 'drug use' or 'substance abuse'. *Licit drug* use means that a drug is used legally, such as alcohol, tobacco and caffeine, and medicines used for illness. These drugs include over-the-counter drugs used as directed, and prescription medicines used by the intended person for prescribed usage. *Illicit drug* refers to a psychoactive substance, the production, sale, or use of which is prohibited. Strictly speaking, it is not the drug that is illicit, but its production, sale, or use in particular circumstances in a given jurisdiction. Most countries have legislation designed to criminalize some drug use, e.g. use of opioids, stimulants, hallucinogens, and cannabis. Drug use may also refer to using a drug, e.g. sedatives or prescription opioids, for an improper purpose. Furthermore, drug use may also refer to a use of substances not intended to be a drug in a way, which produces a drug-like state, e.g. glues or petrol used as inhalants. (WHO 2007)

Variables defining **adolescent substance use** include the presence or absence of any lifetime substance use or substance use disorder (SUD), the age of the subject at substance use initiation, the quantity and frequency of use over defined time periods, and a substance use duration history of multiple substance types. However, not all substance use is problematic. In fact, substance use can be normative and functional. Consuming alcohol to an extent that does not deviate from the norm may be a sign of social behaviour (Schulenberg and Maggs 2002). For example, use of alcohol may be part of social occasions.

However, it can be argued that any use of any substance by an adolescent is substance abuse, because in most Western societies it is illegal for adolescents to smoke cigarettes or consume alcohol, let alone use illegal drugs. Others have stated that experimentation, even with illegal drugs, is a normal part of growing up (Schulenberg and Maggs 2002).

**The stages of adolescent substance use are illustrated in Figure 3.**

**Figure 3. Stages of adolescent substance use**  
Adapted from World Health Organization (2008)



**Experimental use:** Usually, the first few instances of using a particular drug. The term sometimes refers to extremely infrequent or non-persistent use.

**Functional or social use:** Substance use pattern that is not problematic, or a substance use pattern that is socially acceptable.

**Hazardous use:** Substance use that will probably lead to harmful consequences for the user. This concept is similar to the idea of risky behaviour.

**Harmful use:** Use of a drug leading to impaired psychological or social functioning (e.g. academic failure or social problems). Use of a substance that is known to have caused tissue damage or mental illness in the particular person.

**Dependency:** A cluster of behavioural, cognitive, and physiological phenomena that may develop after repeated substance use. Typically, these phenomena include a strong desire to take the drug, impaired control over its use, persistent use despite harmful consequences, a higher priority given to drug use than to other activities and obligations, increased tolerance, and a physical withdrawal reaction when drug use is discontinued.

### 2.1.1 Alcohol

Adolescent alcohol use can be described in numerous ways, and there is no agreement on what is the most accurate method to describe alcohol use at a young age. **Quantity and frequency** of alcohol consumption can be measured retrospectively by estimating the *average daily consumption* and the *average frequency* with which consumption occurs. The assessment timeframe over which data can be obtained from these measures may range from daily recall, to

retrospective recall of drinking in the past year, to lifetime drinking. Measures of *lifetime drinking* ask about average quantities and average frequencies of drinking, but over an entire drinking career or very long time periods. Consumption of alcohol can be described by average quantity per occasion (i.e. number of drinks containing 12 g of pure alcohol in one portion) or average or typical amount of drinking per certain time period (e.g. per week or per month). In addition, maximum quantity and frequency of the maximum quantity are often used to collect information about occasional heavy drinking. (Martin and Winters 1998)

**Patterns of alcohol use** can be described in various ways (**Table 1**). Most commonly, adolescent *binge drinking* refers to a drinking occasion leading to intoxication (Epstein et al. 2004, Kuntsche et al. 2004). A common pattern of alcohol use among adolescents is *heavy episodic drinking* (Kuntsche et al. 2004). Among young people, frequent episodes of *drunkenness* have been described as an indicator of *hazardous alcohol use* (Bailey 1999). However, the behavioural expression of a given level of drunkenness has been estimated to be strongly influenced by cultural and personal expectations about the effects of alcohol (Room and Mäkelä 2000). So far, a thorough assessment of regular alcohol consumption and mean drinking frequency as predictor variables for adolescent alcohol misuse and alcohol-related problems is still lacking (Foxcroft et al. 2003, Foxcroft 2006).

**Table 1. Definitions of alcohol use**

Term	Reference	Definition
Binge drinking	Epstein et al. 2004, Kuntsche et al. 2004	(1) A drinking occasion leading to intoxication, often measured as having more than five (for men) and four (for women) drinks in a row on one occasion (2) A pattern of heavy drinking that occurs over an extended period of time, i.e. several (at least 2) days of extended intoxication with interference in usual obligations and activities. In this definition, binge drinking is more linked to clinical definitions of abuse or dependence
Excessive drinking	WHO 2007	Pattern of drinking considered to exceed some standard of moderate drinking or acceptability, and consumption of quantities of alcohol large enough to be detrimental to the individual's health or social functioning.
Hazardous drinking	WHO 2007	See excessive drinking.
Heavy drinking	WHO 2007	Exceeding a certain daily volume (e.g. two drinks a day) or quantity per occasion (e.g. six drinks on an occasion, at least once a week)
Moderate drinking	WHO 2007	An inexact term for a pattern of drinking that is by implication contrasted with heavy drinking. It denotes drinking that is moderate in amount and does not cause problems. Sometimes, moderate drinking is also contrasted with light drinking.
Problem drinking	WHO 2007	Alcohol use that results in individual or collective, health or social problems. In some usages, problem drinking is assimilated to the alcoholism concept as an earlier or less serious stage
Drunkenness	WHO 2007	Intoxication of alcohol is a condition that follows the administration of alcohol and is manifested by such signs as facial flushing, slurred speech, unsteady gait, euphoria, increased activity, volubility, disorderly conduct, slowed reactions, impaired judgement and motor incoordination, insensibility, or stupefaction



## 2.1.2 Cigarette smoking and nicotine dependence

Tobacco is defined as any preparation of the leaves of *Nicotiana tabacum*. The main psychoactive ingredient is nicotine. Nicotine is an alkaloid, which is the major psychoactive substance in tobacco. Nicotine is most commonly used in the form of inhaled tobacco smoke, and smokers regulate the way they puff and inhale to achieve their desired nicotine dose. Tobacco smoking is the act of smoking tobacco products especially cigarettes and cigars. Nicotine can also be used as "smokeless tobacco" (such as chewing tobacco), snuff, or nicotine gum (WHO 2007).

*Cigarette smoking frequency* is often described as the average number of smoked cigarettes per certain period. Reports are often obtained for one or more reference periods, e.g. number of cigarettes smoked per day or per week, or smoking days per month. Also here, the measures of *lifetime smoking or tobacco use* ask about average quantities and average frequencies of smoking or tobacco, but over an entire tobacco career or very long time periods. When estimating lifetime smoking, previous smoking and quitting and lifetime quitting attempts can also be assessed. Studying patterns of cigarette smoking topography, the unique way an individual puffs a cigarette, provides information about behaviors influencing nicotine exposure. Nicotine use can also be measured with *biomarkers*, such as cotinine (the major metabolite of nicotine) measures derived from saliva, urine, or blood, and concentrations of carbon monoxide levels in expired air (WHO 2007). Adolescents have different smoking patterns than adults, such as inhalation behaviours, irregular smoking, or smoking less because of restrictive environments (e.g. school and home) that may influence the measurement of smoking outcome (Corrigan et al. 2001).

**Nicotine dependence** is defined as a physical dependency manifesting as a withdrawal syndrome, which develops within a few hours of the last nicotine dose: craving for a smoke, irritability, anxiety, anger, impaired concentration, increased appetite, decreased heart rate, and sometimes headaches and sleep disturbances. Craving peaks at 24 hours and then declines over a period of several weeks, although it may be evoked by stimuli associated with previous smoking habits (WHO 2007). In many studies, the primary self-report measure of nicotine dependence is the Fagerström Tolerance Questionnaire (FTQ) and several modifications of it (Kandel et al. 2005).

## 2.1.3 Illicit drugs

Illicit drugs are psychoactive substances, of which the production, sale, or use are prohibited according to the law, or banned by international drug control treaties. They commonly include cannabis products (marijuana and hashish); stimulant drugs (e.g. amphetamines and cocaine); so-called dance-party drugs (e.g. 3, 4-methylenedioxymethamphetamine (MDMA), also known as ecstasy); hallucinogens (e.g. lysergic acid diethylamide (LSD), psilocybin, and mescaline), and illicit opioids (e.g. heroin and opium) and diverted pharmaceutical opioids (e.g. buprenorphine, methadone, and morphine) (WHO 2007).

The term *recreational drug use* has been used to describe occasional illicit drug use for pleasure rather than because of an addiction, and without personal, educational or social deficits expressing divergent involvement with illicit drugs (Parker and Aldridge 1998). This term may be disfavoured by those seeking to define all illicit drug use as a problem (WHO. 2007). Illicit drug use can be defined as (1) presence of any lifetime substance use history in any drug category; (2) the onset ages for first and regular use in each relevant drug category; (3) the typical frequency and quantity ingested when the client has been using the drug regularly; (4)

abstinence periods, i.e. when the particular drug has not been used; and (5) the extent of simultaneous and sequential polydrug use (Clark and Winters 2002). In most of the studies, alcohol and tobacco quantity is more readily determined than is the case for most illicit substances (Clark and Winters 2002).

#### 2.1.4 Substance use disorders

Substance-related disorders are disorders of intoxication, dependence, abuse, and substance withdrawal caused by various substances, both legal and illegal. The most widely used definitions for substance use disorders (SUDs) are those determined by editions of the Diagnostic and Statistical Manual of Mental Disorders (DSM) of the American Psychiatric Association (APA), and the International Classification of Diseases (ICD) of the World Health Organization (WHO). DSM-IV (4<sup>th</sup> Edition) and ICD-10 (10<sup>th</sup> Edition) diagnostic criteria define two disorders, **dependence**, and a secondary category called **abuse** in DSM-IV, and **harmful use** in ICD-10 (APA 1994, WHO 1992, WHO 2007). In both DSM-IV and ICD-10, only individuals without dependence are diagnosed with abuse or harmful use, and a definite diagnosis of dependence should usually be made only if three or more of the dependency symptoms have been present together at some time during the previous year. DSM-IV and ICD-10 also provide substance-specific intoxication and withdrawal symptoms, and methods for diagnosing substance-induced psychiatric disorders. The substances specified are alcohol, opioids, cannabinoids, sedatives or hypnotics, cocaine, other stimulants including caffeine, hallucinogens, nicotine, and volatile solvents. In DSM-IV, one of four abuse criteria is required. One of these criteria is hazardous use, use that elevates the risk of physical harm. In contrast, ICD-10 has only one criterion, harmful use, indicating that physical or psychological harm has actually taken place. Comparisons of DSM-IV and ICD-10 SUD definitions indicate considerable agreement for dependence but fewer similarities between systems for abuse and harmful use (Hasin et al. 2006). Furthermore, reliability and psychometric validity evidence for substance dependence is consistently strong, but more mixed for abuse and harmful use (Hasin et al. 2006). **Addiction** as a term is often described as a synonym for substance use dependency. However, from a physiologic standpoint, dependency refers more to a physical dependence including withdrawal symptoms. Accordingly, addiction can be defined as a broader term to describe lack of control over using a certain substance, but also certain behaviours, e.g. gambling (Stinchfield. 2003). **Misuse of a drug or alcohol** is described as use of a substance for a purpose not consistent with legal or medical guidelines, as in the non-medical use of prescription medications. The term is preferred by some researchers in the belief that it is less judgmental.

The diagnostic criteria of SUDs have been developed using theory about and data collected from adults, and may not apply as appropriately to young people (Martin et al. 1995, Martin and Winters 1998, Harrison et al. 1998). For instance, some symptoms of substance use dependence reveal very low base rates among young people, as in the case of withdrawal symptoms and related medical problems, which normally emerge after years of continued drinking or drug use. Lately, the term **diagnostic orphans** has started to be used to describe those who meet one or two dependence criteria only, and do not meet diagnostic criteria for dependence, abuse or harmful use (Martin et al. 1995, Harrison et al. 1998, Sarr et al. 2000). Diagnostic evaluation process adapted from Harrison et al. (1998) is presented in **Figure 4**. Furthermore, young people often develop substance abuse and/or substance dependence on several different substances. The diagnostic criteria for any specific substance may not be met, although substance-use-related problems are obvious. It is not yet well understood how the developmental differences impact diagnoses of substance use disorders in young people (Ridenour et al. 2006).

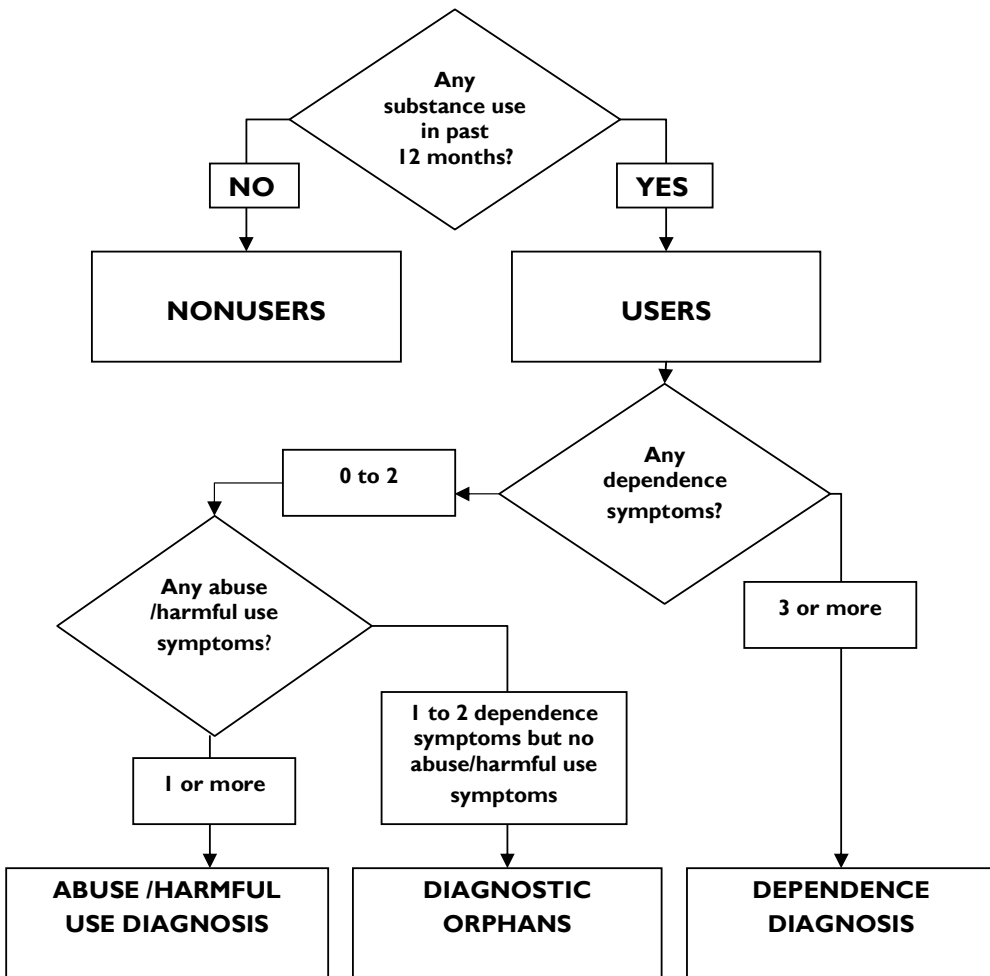


Figure 4. Substance use disorder decision tree modified from Harrison et al. 1998

## 2.2 Reliability and validity of self-reported substance use

Screens and measures should be both valid and reliable to be useful for either clinical or research purposes. Self-reports provide the most direct information about a person's alcohol and other drug use and associated problems, and surveys usually rely on self-reporting and recall (Martin and Winters 1998). Methods used to obtain information include those of face-to-face interview, self-administered questionnaire, or telephone interview. It has been estimated that face-to-face interviews provide lower level of substance compared to self-administered questionnaires (van Griensven et al. 2006). Furthermore, evidence points towards that many parents may not be aware about substance use of their offspring and may underreport substance use of their offspring compared with the report of the offspring him/herself (Martin and Winters 1998, Clark and Winters 2002, Fisher et al. 2007). Therefore, substance use behaviours should always be assessed directly from young people themselves (Fisher et al. 2007).

In general, **reliability** levels have found to be high for self-reported alcohol and drug use and smoking (O'Malley et al. 1983, Patrick et al. 1994, Johnson and Mott 2001, Brener et al. 2003, Post et al. 2005). The test-retest reliability of self-reported alcohol use among young people has been shown to be good, ranging from 0.8 to 0.9 (Levy et al. 2004, Reinert and Allen 2007). So far, research findings have not been conclusive with regard to the best way to measure alcohol consumption (Gmel et al. 2006).

Reliability of self-reported illicit drug use may not be as high as it is for alcohol use or cigarette smoking, particularly among young adolescents (Percy et al. 2005). Furthermore, retrospective questions assessing age of initiation of substance use tend to elicit inaccurate responses among young people, which are, at least in part, a function of forgetting over time. In longitudinal studies, reports of ever having used a substance tend to be more reliable than reports of frequency of use during particular time periods (Brener et al. 2003). Young people may also be inconsistent about their self-reported substance use for substances they have used on an infrequent basis (Allen and Wilson 2003, Percy et al. 2005, Stanton et al. 2007). A higher level of recounting previous substance use has found to be more prevalent among males compared to females (Percy et al. 2005, Stanton et al. 2007). Also lower socio-economic status and psychiatric problems, like depression, have been suggested to associate with a higher level of recounting (Stanton et al. 2007).

Of **validity** issues, questions about typical quantities of alcohol consumed may lead to underestimates, as do questions about drinking 'standard drinks' of alcohol (Poikolainen and Kärkkäinen 1985). Underestimating may be most evident among young males (Stockwell et al. 2004). Prospective use of a diary has been estimated to be the best method to detect the most accurate level of alcohol use (Poikolainen and Kärkkäinen 1983, Poikolainen and Kärkkäinen 1985). Among adults, the coverage of self-reported consumption has ranged in various studies from 0.29 to 0.83 (Poikolainen 1994).

Furthermore, validity issues of adolescent screening instruments are central, as most of the widely used screening tests have been developed to screen problematic substance use among adults. For example, the Alcohol Use Disorders Identification Test (AUDIT) cut-off point of eight has shown a sensitivity of 0.9 and a specificity of 0.8 to identify adult at-risk alcohol users (Reinert and Allen 2007). Among a population-based sample of adolescents, an AUDIT cut-off point of four has shown to produce sensitivity of 0.9, and specificity of 0.8 (Reinert and Allen 2007). In a sample of 14- to 18-year-old patients receiving care in a hospital-based clinic, a cut-off point of two was found to be optimum for identifying any alcohol problem (sensitivity 0.9; specificity 0.8), and that three points could be recommended as a cut-off for identifying abuse (sensitivity 0.9; specificity 0.8) or dependence (sensitivity 1.0; specificity 0.7) (Reinert and Allen 2007). In a meta-analysis by Patrick et al. (1994), comparisons between self-reported behaviour and biochemical markers provided a sensitivity from 0.1 to 1.0 (mean=0.9), and a specificity from 0.3 to 1.0 (mean=0.9).

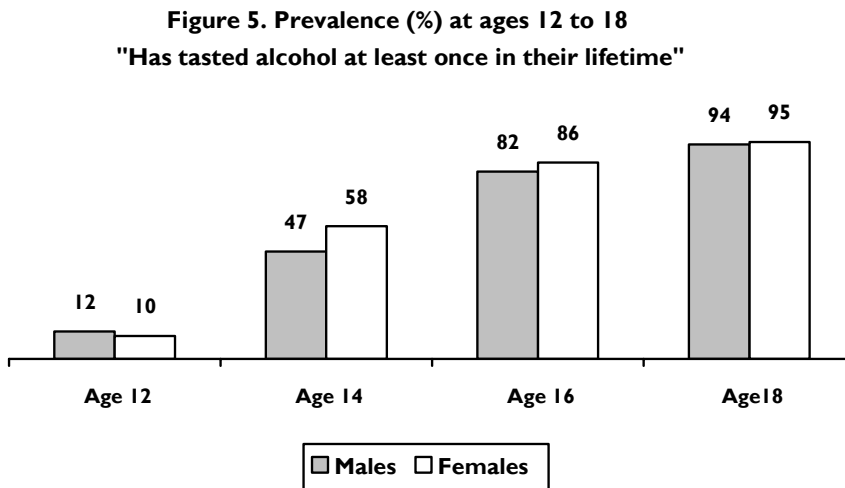
Ensuring the confidentiality of self-reports, clearly worded objective questions (e.g. "How many times have you been arrested for drunk driving?"), using biological assays such as urinalysis, and using standardized tests appear to increase the reliability of self-reports (Babor et al. 1987, Allen and Wilson 2003). Compared to interviews, also the use of new technology, such as palmtop-assisted or audio-computer-assisted self-interviewing provide a scientifically acceptable alternative for collecting substance use data (McCabe et al. 2005, van Griensven et al. 2006).

## 2.3 Substance use behaviours at young age

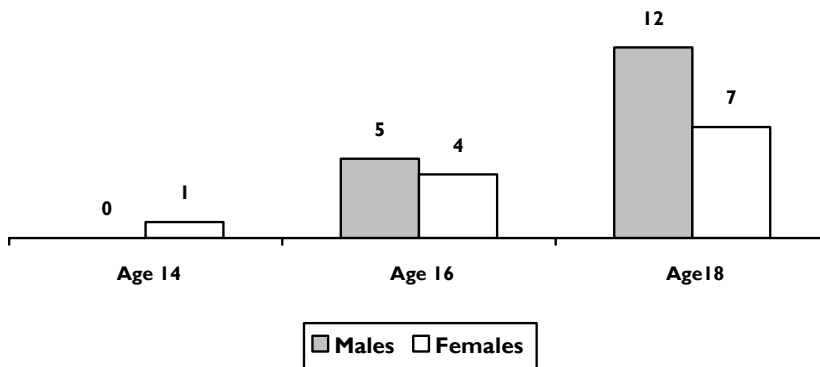
### 2.3.1 Alcohol

Most commonly, young people's first experience of alcohol is at the age of 15 years or earlier (Kosterman et al. 2000, Essau et al. 2002, Rimpelä et al. 2005, Sung et al. 2004). The rate of lifetime abstinence declines with age, and nearly all 18-year-old adolescents have at least experimented with alcohol. The estimated lifetime prevalence of alcohol use among 18-year-old adolescents varies across nations from 80.0 to 94.8% (Essau et al. 2002). Drinking style becomes drunkenness-orientated with age (Lintonen et al. 2000), while access to licensed premises at age 18 increases alcohol consumption (Casswell et al. 2002). It has been estimated that, in Finland, the binge drinking frequency is among one of the highest in Europe for the age group of 18-29 years (Kuntsche et al. 2004, The European School Survey Project on Alcohol and Other Drugs (ESPAD) 2003). In a Finnish study by Pirskanen (2007), 59% of 14–15-year-olds, and 23% of 16–18-year-olds reported being abstinent. In that study, 10% of the 14–15-year-olds, and 45% of the 16–18-year-olds consumed at least five alcoholic drinks on one drinking occasion.

The prevalence of alcohol use according to the Finnish Adolescent Health Habit and Lifestyle Survey in 2005 are presented in Figures 5 and 6.



**Figure 6. Point prevalence (%)**  
**"Really drunk once a week or more often"**



The frequency of lifetime adolescent **alcohol use disorders** (AUD) in epidemiological studies has been found to vary from 3.5% to 32.4%, being more common among males than females (Essau et al. 2002). Among Finnish young adults (20-24 years) with an upper secondary school education, one-month prevalence for AUD in 1995 was 6.2%: 7.3% in males, and 5.3% in females (Aalto-Setälä et al. 2001).

**Drinking habits** are often maintained from late adolescence to adulthood. Those with heavier consumption of alcohol in their mid-teens tend to be those with heavier consumption or alcohol-related problems later in life (Andersen et al. 2003, Chen and Kandel 1995, Wells et al. 2004). Alcohol consumption, problems and diagnoses have been found to peak at around age 21 (Chen and Kandel 1995, Jernigan 2001). However, a substantial proportion of young heavy drinkers overcome their alcohol problems and change to abstinence or normative drinking (Toumbourou et al. 2004, Wells et al. 2006). Approximately 10% of young people continue their pattern of heavier or more frequent alcohol use, and may manifest chronic alcohol dependence in later life (Chen and Kandel. 1995). Across nations and different age stages, males have been found to be less likely lifetime abstainers, to drink more frequently, in larger amounts, and with higher rates of adverse consequences than females (Wilsnack et al. 2000).

### 2.3.2 Cigarette smoking

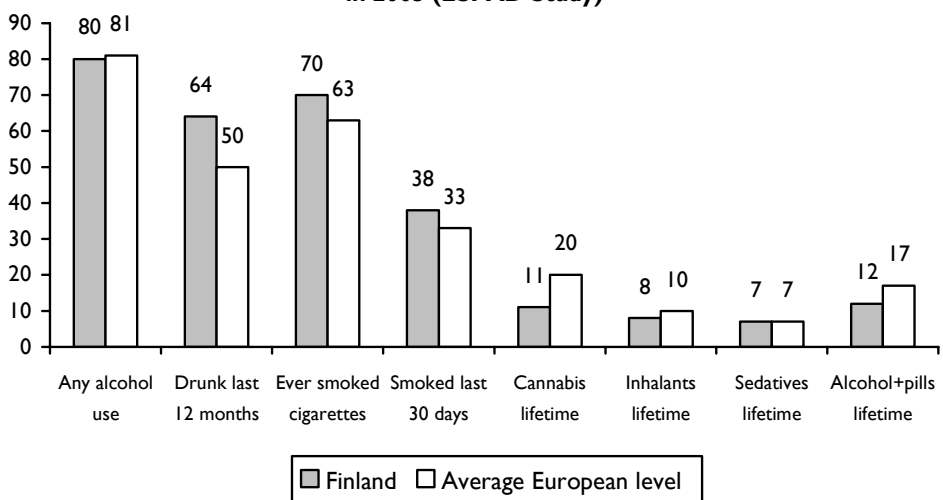
Tobacco is often the first addictive substance experimented with by adolescents, the first use of cigarettes often taking place at age 11 to 13 years (Essau et al. 2002, Substance Abuse and Mental Health Services Administration (SAMSHA) 2006). During the last three decades, the age of first cigarette experiments has been delayed: in Finland in 1977, 50% of 12-year-old boys reported experimenting with cigarettes, while the respective figure was 17% in 2005 (Rimpelä et al. 2005). Most tobacco users develop their smoking behaviour in adolescence, with very few people beginning their smoking habit as adults (Chen and Kandel 1995, Brown et al. 1996). According to Finnish Adolescent Health Habit and Lifestyle Survey in 2005, 78% of 18 year-old boys had lifetime experimenting with cigarettes, 34% smoked daily, and 24% smoked at least 9 cigarettes a day (Rimpelä et al. 2005). Respective figures for girls were 78%, 33%, and 16%. In another Finnish study, smoking was reported by 24% of the 14- to 18-year-old adolescents (Pirskanen 2007). Smoking more than 10 cigarettes a day has been found to associate strongly with nicotine dependence (Kandel and Chen 2000). According to a study from the United

States, 20-60% of adolescent smokers are dependent on nicotine (Kandel and Che. 2000). It has been estimated that among adult smokers, only 5% of the smokers are not addicted to nicotine (Hughes 2006).

### 2.3.3 Illicit drug use

Prevalence estimates of drug use vary greatly by nation, cannabis being the most common drug used (European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) 2006, SAMSHA 2006). Illicit drug use typically begins in the mid to late teen years and reaches its maximum in the early 20s, before declining in the mid to late 20s (Chen and Kandel 1995, Kosterman et al. 2000, von Sydow et al. 2001). Only a minority of young adults continues to use illicit drugs into their 30s (Chen and Kandel 1995). Adolescents in developed societies typically use alcohol and tobacco before using cannabis, which in turn, they use before using other illicit drugs (Kandel 1975, Walker et al. 2004, Fergusson et al. 2006). Furthermore, concurrent use of multiple substances has been found to associate with a significantly higher prevalence of SUDs compared to the non-users or those using merely one substance, most commonly alcohol (Wu et al. 2005). The lifetime prevalence for illicit drug use in adolescence varies from 6% to 54 % (Essau et al. 2002). The prevalence of illicit drug use is significantly lower in Finland compared to other European countries, see **Figure 7** (ESPAD 2003, EMCDDA 2006), or the United States on average (SAMSHA 2006). According to the Finnish Adolescent Health Habit and Lifestyle Survey in 2000, the percentage for lifetime illicit drug use among 15-17-year-old adolescents was 21-31 %, and the lifetime prevalence for using illicit drugs more than five times was 5-11% (Luopa et al. 2005). Among Finnish young adults in 1995, 21.4% of the subjects reported using cannabis at some time, and most of them (89.2%) had tried cannabis not more than once or a few times (Poikolainen et al. 2001a). The one-month prevalence of cannabis abuse was 2.7% (Aalto-Setälä et al. 2001). In Finland, cannabis is most commonly used by 15-24-year-olds, whereas other illicit drugs are used most by 25-34-year-olds, most commonly men (Finnish Research and Development Centre for Welfare and Health (STAKES) 2007).

**Figure 7. Prevalences (%) of substance use among 16-year-old adolescents in 2003 (ESPAD Study)**



### 2.3.4 Course of substance use at young age

Adolescent substance use has been found to predict substance-use-related problems in early adulthood (see, e.g. Poikolainen et al. 2001b, Ellickson et al. 2003, Wells et al. 2004). Costello et al. (1999) have estimated that the time period from the first alcohol use experiment without parent's permission to substance abuse or substance dependence diagnosis is six years. Furthermore, the earlier the age of substance use initiation, the greater is the risk of problematic substance use later in life (Fergusson et al. 1994a, Hawkins et al. 1997, DeWit et al. 2000, Wells et al. 2004, Pitkänen et al. 2005). It has been argued that it is adolescent heavy episodic drinking, not alcohol use *per se*, which predicts later AUD (Guo et al. 2000). However, in a prospective study of Swedish conscripts, also moderate levels of alcohol use at the time of the military call-up were found to increase the risk of later AUD (Andréasson et al. 1993).

The *gateway hypothesis* holds that consumption of abusable drugs progresses in an orderly fashion through several discrete stages, beginning with legal, socially acceptable compounds that are low in the hierarchy (alcohol and/or cigarette smoking), followed by use of illegal "soft drugs" (cannabis) and later "hard" drugs (stimulants and opioids), ranked higher in the hierarchy (Kandel 1975, Kandel and Yamaguchi 1993). Tobacco use has been found to predict subsequent alcohol use better than the converse (Wetzels et al. 2003). Tobacco use in adolescence and continued use in adulthood has also been associated with increased risk for poorer functioning across multiple domains, including physical and mental health (Georgiades and Boyle 2007). Kandel and Jessor (2004) have also stated that increased risk of transition through the drug sequence is associated more strongly with intensity of use than with use *per se*. Furthermore, the risks of use, abuse or dependence, and the use of a diversity of other drugs have been found to decline with increasing age (Fergusson et al. 2006). The order of progression is not universal and may reflect cultural factors (Wetzels et al. 2003).

Concerning alcohol use, Wells et al. (2004) have reported that the extent and pattern of drinking at age 16 was found to be directly related to frequent use of alcohol, heavy occasional drinking, alcohol dependency and drunk-driving at age 21-25, but did not predict other forms of dependency when adjusted with a wide range of psychosocial covariates. Thus, adolescent drinking may not be related causally to other forms of substance dependency. These associations may arise in part because drinking is embedded in clusters of lifestyles associated with nicotine and drug dependency (Wells et al. 2004).

Fergusson et al. (2006) indicated that regular or heavy cannabis use increases the risk of using other illicit drugs, abusing or becoming dependent upon other illicit drugs, and using a wider variety of other illicit drugs. This was found to be particularly evident during adolescence, declining rapidly with increasing age (Fergusson et al. 2006). Findings from the same study cohort also revealed that subjective early positive responses to cannabis are prognostic of later cannabis dependence (Fergusson et al. 2003a). In a Finnish study of young adults, frequent heavy drinking was found to be more prevalent among those reporting higher scores of relief smoking and relief drinking, e.g. to reduce anxiety and depressive feelings (Poikolainen et al. 2001b). In line with the gateway theory, in an Australian study of young adults, the strongest predictor for amphetamine use was the earlier use of other drugs, particularly cannabis, but not psychological distress (Degenhardt et al. 2007). The other way around, weekly use of cannabis use during the teens and early adulthood has been associated with an increased risk of late initiation of tobacco use and progression to nicotine dependence (Patton et al. 2005). Besides prior substance use, and other individual factors, also several environmental factors influence the progression of substance use behaviour. For instance, findings from a German study indicated that cannabis use



was predicted mainly by availability of drugs, peers' drug use, a more positive attitude towards future drug use, and regular previous use of licit drugs (von Sydow et al. 2002). In that study, cannabis dependence was predicted by parental death before age 15, deprived socio-economic status, and previous use of other illicit drugs (von Sydow et al. 2002).

## 2.4 Childhood risk factors for substance use

**A risk factor** is defined as a variable of characteristics, which increases the likelihood of an individual developing a disorder, compared with someone else without the risk factor (Kazdin et al. 1997). Crucial to the definition of the risk factor is the requirement that it precedes the outcome of interest (Kraemer et al. 1997). Furthermore, the profile of risk factors may depend on population characteristics (Kraemer et al. 1997). A risk factor for substance use or abuse can be an individual attribute, an individual characteristic, a situational condition, or an environmental context that increases the probability of substance use or abuse, or a transition in the level of involvement with substance use (Clayton 1992).

However, one must note that the aetiology of substance use is not the same as the aetiology of substance abuse or SUD, and might even vary for the abuse of particular substances. Experimentation and infrequent substance use tend to be more related to peer and social factors, whereas substance abuse or dependence tends to be more associated with individual, e.g. biological and psychological factors (Rhee et al. 2003). Furthermore, it must be noted that risk always describes the probability of developing the problem over a time period, and it is measured as average risk in a particular population (Schwartz and Susser 2006b). Therefore, not all individuals with a certain risk factor develop a problematic pattern of substance use.

Risk factors for substance use can be studied in various study settings. In **cohort studies**, exposed and unexposed individuals are compared with regard to a hypothesized risk factor (Schwartz and Susser 2006a). In **population studies**, the study cohort is collected from a naturally occurring population, and the exposed and unexposed individuals are identified within the same population (Schwartz and Susser 2006a). **A birth cohort** is defined as a group of people born in a particular year, or within a range of birth years, and may be referred to as an *age cohort* (Schwartz and Susser 2006a). **Twin studies** are aimed to estimate heritability using sets of twins. Longitudinal twin studies may also help to clarify the developmental pathways through which genes and environment contribute to risk for SUDs (Kendler 2001). **High-risk family studies** refer to family studies that prospectively investigate the development of psychopathology among offspring of parents with psychopathology compared to offspring of parent controls (Avenevoli and Merikangas 2006).

**Table 2 presents a summary of longitudinal studies determining childhood risk factors for subsequent substance use or SUD.**

**Table 2. Summary of longitudinal studies<sup>1</sup> determining childhood risk factors for subsequent substance use or SUD.**

Birth Cohort Studies		Childhood psychopathology instruments and informants	Other relevant childhood measures	Data collection and measures of substance use/abuse at follow-up
Study and location Reference	Participants <sup>2</sup> and setting, Age at baseline	Follow-up		
<b>Christchurch Health and Development Study</b> New Zealand e.g. Fergusson et al. 1993, Lynskey and Fergusson, 1995, Fergusson et al. 2007a	Birth cohort of 1265 children (635 boys) born in Christchurch, New Zealand mid-1977.	1977-ongoing Assessments at 4 months (1977), annually at age 1-16 (1978-1996), age 18 (1998), age 21 (2001), age 24 (2004) Attrition at 24-year follow-up 20%.	Age 7, 8, 9, 12: Questionnaire (Rutter, Conner's); parent, teacher Age 8,9: IQ (WISC)	Age 7-9: Self-reported alcohol use (RAP); parent perceptions and knowledge of child's substance use Age 15, 18,21,25: cigarette smoking during the past month, alcohol use during the last 12 months, cannabis and other illicit drugs within past 3 years; ND, AUD, DUD diagnoses (diagnostic interview)
<b>Dunedin Birth Cohort Study</b> New Zealand e.g. Henry et al. 1993 Arseneault et al. 2000 Arseneault et al. 2003 McGee et al. 2000 Ogders et al. 2007	Birth cohort of all children born in the only obstetric hospital in the Dunedin metropolitan area in New Zealand between April 1 1972, and March 31 1973; who were still resident locally when the study began in 1975. 1037 3-year-old children (535 boys) were recruited. Attrition at baseline 9%	1975 – ongoing Assessments biannually at age 3-15 (1975-88) 18 (1990-91) 21 (1993-94) 26 (1998-99) 32 (2003-05) years. Attrition at 32-year follow-up 4%.	Age 3, 5, 7, 9 Age 11: Diagnostic interview (DISC); parent, child	Age 9 self-reported smoking frequency Age 11: self-reported smoking frequency, alcohol experience, knowledge, attitudes Age 13, 15: self-reported use of tobacco, alcohol, cannabis and other drugs, glue sniffing during the last 12 months Age 18, 21, 26: ND, AUD, DUD diagnoses (diagnostic interview)
<b>Great Smoky Mountains Study of Youth</b> North Carolina, United States E.g. Costello et al. 1999 Costello, 1996 Kaplow et al. 2001 Sung et al. 2004 Costello et al. 2007	Random selection (38%) from three birth cohorts. Children who scored in the top 25% on the screening CBCL questionnaire, together with a 1 in 10 random sample of the rest, were recruited. Altogether 1420 children (790 boys); 9,11,13-year-olds were recruited.	1992-ongoing Assessments annually until age 16 At each wave, between 6% and 13% refused to take part (average across waves 8%).	Diagnostic interview (CAPA); child and parent	Annually: Self-reported lifetime use, age of onset, use in the last 3 months (tobacco alcohol without adult permission), and illicit drugs; ND, AUD, DUD diagnoses (diagnostic interview)

Table 2. Summary of longitudinal studies<sup>1</sup> determining childhood risk factors for subsequent substance use or SUD.

Birth Cohort Studies, continued		Childhood psychopathology instruments and informants			Other relevant childhood measures		Data collection and measures of substance use/abuse at follow-up	
Study and location Reference	Participants <sup>2</sup> and setting, Age at baseline	Follow-up	Childhood psychopathology instruments and informants	Other relevant childhood measures	Data collection and measures of substance use/abuse at follow-up			
<b>Dutch Epidemiological Sample Province of Zuid-Holland</b> (Netherlands) e.g. Ferdinand et al. 2001 Ferdinand et al. 2005 Huizink et al. 2006	Random sample of 2076 4-17-year-old children (1016 boys) drawn from municipal registers that list all residents. Attrition at baseline 21%	1983 – ongoing Assessments at age 10-14 (1989), 12-16 (1993), and 14-18 (1997) years. Attrition for the 14-year follow-up period 21%	Questionnaire (CBCL); parent Diagnostic interview (CIDI)		Every wave: Self-reports of substance use onset, life-time use, and alcohol, tobacco and drug use frequency within past 6 months; Age 18-31: AUD, DUD diagnoses (diagnostic interview)			
<b>Mater University study of pregnancy and its outcomes (MUSP)</b> Australia e.g. Alati et al. 2006, Hayatbakhsh et al. 2006, Alati et al. 2008	Baseline data were collected at the first antenatal visit in the one obstetric hospital from 7223 women who gave birth to live singleton babies. Attrition from the original target population 15%.	1981-1983 – ongoing. Assessments at 3-5 days, 6 months, 5, 14 and 21 years after birth. Attrition at 21-year follow-up 56%	Age 5: Questionnaire (CBCL); parent	Maternal anxiety and depression at birth, maternal alcohol and tobacco consumption during pregnancy, child's health, growth and development,	Age 14 and 16: self-reported quantity of alcohol consumption an any drinking occasion, self-reported cigarette smoking frequency Age 21: AUD, DUD diagnoses (diagnostic interview)			
<b>Other population-based studies</b>								
<b>Pittsburgh Youth Study</b> United States e.g. Loeber et al. 1999, Loeber and Farrington, 2000, White et al. 2001 Burke et al. 2007, Pardini et al. 2007	Three random samples of 7-, 10- and 13-year-old boys. Total n=1517 from public schools in Pittsburgh. Attrition at baseline 15%. The top 30% of those with the highest rates of antisocial behaviour (approximately 250) along with 250 randomly drawn from the remainder were selected to participate in follow-up	1987-ongoing Assessments every 6 month for the first 3 years (1987-89); then annually (1990-2000) until age 20 / 25 years Attrition for the 12-year follow-up period 15.4% (oldest cohort).	Questionnaire (MFQ); parent and child; Diagnostic interview (DISC); parent, child	Family History Questionnaire (FHQ) Parental and peer substance use	Self-reported lifetime use of alcohol and illicit drugs; Age 20, 25 (oldest cohort); AUD, DUD diagnoses (diagnostic interview)			

Table 2. Summary of longitudinal studies<sup>1</sup> determining childhood risk factors for subsequent substance use or SUD.

Other population-based studies, continued					
Study and location Reference	Participants <sup>2</sup> and setting, Age at baseline	Follow-up	Childhood psychopathology instruments and informants	Other relevant childhood measures	Data collection and measures of substance use/abuse at follow-up
<b>Simmons Longitudinal Study</b> (Boston, United States) Reinherz et al. 2000	All 5-year-old children (n=763, 385 boys) entering kindergarten in one public school district in 1977. Attrition at baseline not reported.	1977-ongoing Assessments at age 5 (1977), age 6-9, 15, 18, 21, and age 26 (1998) Attrition for the 21-year follow-up period 27.6%	Questionnaire PBQ, CAAP; teacher (age 6,9) SBCL; mother (age 5, 9) PH; child (age 9)	Demographic information, psychiatric histories of parents and siblings, family functioning	Age 18, 21: Self-reported drug and alcohol use; AUD, DUD diagnoses (diagnostic interview)
<b>Children in the Community Study</b> , (New York, United States) e.g. Brook, et al. 1995 Brook et al. 1998 Brook et al. 1999 Brook et al. 2000 Brook et al. 2002	Randomly selected cohort of families; one child aged 1-10 years from every family was selected (n=976). Attrition at baseline 15%	1975- ongoing Assessments at age 9-18 years, 12-21 years, and 18-27 years Attrition for the 18-year follow-up period 21%.	Mother's face-to-face interview Diagnostic interview (DISC-interview); mother	Parental drug use, sibling factors, family functioning, childhood maltreatment	Self-reported drug and alcohol use; AUD, DUD diagnoses (diagnostic interview)
<b>Woodlawn Project</b> Chicago, United States e.g. Kellam et al. 1980 Ensminger et al. 1982 Ensminger et al. 2002 Fothergill and Ensminger 2006 Juon et al. 2002 Crum et al. 2006	African American cohort of 6-7-year-old children (n=1242) from impoverished Chicago community recruited in 1966-1967. Attrition at baseline 31%.	1966-ongoing Assessments at 6-7 years, 15-17 years, and 32-33 years (1966-67, 1976-77, 1992-94). Attrition for the 28-year follow-up period 24%	Questionnaire (TOCA); teacher IQ and school readiness tests	Family and parental factors, psychological problems, sexual behaviour, employment, religiosity	Self-reported drug and alcohol use; SUD diagnoses (diagnostic interview)

**Table 2. Summary of longitudinal studies<sup>1</sup> determining childhood risk factors for subsequent substance use or SUD.**

Other population-based studies, continued		Childhood psychopathology instruments and informants			Other measures	Data collection and measures of substance use/abuse
Study and location Reference	Participants <sup>2</sup> and setting, age at baseline	Follow-up				
<b>Seattle Social Development Research Project</b> Seattle, United States e.g. Catalano et al. 1996, Hawkins et al. 1997, Hill et al. 2000, Guo et al. 2000, Guo et al. 2001	Fifth-grade elementary school students in high-crime neighborhoods in Seattle (n=808, 412 boys). Attrition at baseline 23%	1985 - ongoing Assessments annually at age 10-18, and at age 21. Attrition for the 11-year follow-up period 6%	Ages 10 and 14: Questionnaire (CBCL); parent, teacher	Parenting practices, parental alcohol use and attitudes towards alcohol use, family functioning, peer relations, attitudes towards school and court records on youth offences, self-reported involvement in criminal behavior	Ages 12-16 annually, 18 and 21: ever use and current use of alcohol, smoking, and use of illicit drugs Ages 13-18, and 21: heavy episodic drinking (last month), perceived alcohol use. Age 21: SUD diagnoses (diagnostic interview)	
<b>Montreal Longitudinal-Experimental Study</b> Montreal, Quebec, Canada e.g. Tremblay et al. 1992 Masse and Tremblay. 1997 Carbonneau et al. 1998	French-speaking, nonimmigrant 6-year-old boys (n=1034) from 53 low socioeconomic French-speaking schools. Attrition at baseline not reported.	1985-ongoing Assessments at 11, 12, 13, 14, and 15 years; Attrition for the 9-year follow-up period 25%	Questionnaire Temperament and personality dimensions; teacher Prosocial Behaviour Questionnaire(PBQ); peers, child	Self-reported alcohol and drug use, cigarette smoking during the past 12 months; age of onset		
<b>Ontario Child Health Study</b> Ontario, Canada e.g. Boyle et al. 1993, Georgiades and Boyle. 2007	Stratified, clustered and random sampling including children aged 4-16 years and living in Ontario (n=3294) Attrition at baseline 9%	1983- ongoing Assessments at 8-20 years (1987), and 21-33 years (2001). Attrition for the 17-year follow-up period 41%	4-16 years: Questionnaire (CBCL); parent, teacher 12-16 years: Questionnaire (YSR) and structured interview; parents, children	Somatic health, injuries, parental health and alcohol use, family relationships	Age 12-16: Self-reported cigarette smoking, alcohol use and cannabis use (lifetime use, during the past 12 months) Age 17-21: SUD diagnoses (diagnostic interview)	

**Table 2. Summary of longitudinal studies<sup>1</sup> determining childhood risk factors for subsequent substance use or SUD.**

Twin studies		Childhood psychopathology instruments and informants			Other measures	Data collection and measures of substance use/abuse
Study and location Reference	Participants <sup>2</sup> and setting, age at baseline	Follow-up				
<b>FinnTwin12 Study</b> Finland, nationwide Rose. 2001 e.g. Latendresse et al. 2008	Twin pairs (age 11-12, years) born in Finland between 1983 and 1987 (n=5600), and a subsample of 1035 families. Attrition at baseline 17%	1995 -ongoing Assessments at age 14, 17 Attrition for the the 3-year follow-up period 6%	Questionnaire (MPNI);parent, teacher	Pubertal development scale, parental monitoring, home atmosphere, peer substance use	Age 12: alcohol-related problems (parent questionnaire) Ages 14, 17: Self-reported alcohol use and smoking frequency, lifetime use of alcohol, frequency of alcohol intoxication, alcohol attitudes Subsample: SUD diagnoses (diagnostic interview)	
<b>Minnesota Twin Family Study United States</b> e.g. King et al. 2004	Minnesota Twin Family Study includes epidemiological investigations of 11-year-old twins identified from public birth records. Age at baseline (1990–94 for boys; 1993–96 for girls)10-12 yrs N=1402 (694 boys) Attrition at baseline 17%	1993–97 for boys; 1996–99 for girls - ongoing  Attrition at the follow-up (mean age 14.8 years) not reported	Diagnostic interview (DICA-R); parent, child	Family and peer relations	Self-reported lifetime use and use of tobacco, alcohol, and cannabis during the past 12 months; ND, AUD, DUD diagnoses (diagnostic interview)	
<b>Virginia Twin Study of Adolescent Behavioral Development United States</b> e.g. Maes et al. 1999 Silberg et al. 2003	School-based ascertainment of 1439 families (n=2878,46% boys) throughout the state. Twins aged 8–16 years in 1987. Attrition at baseline 9%.	1987- ongoing  Total attrition not adequately reported	Diagnostic interview (CAPA); parent, child Questionnaires: parent, child	Family and peer relations	Child and parent reported substance use (alcohol, tobacco, drug use) within the past 3 months.	

**Table 2. Summary of longitudinal studies<sup>1</sup> determining childhood risk factors for subsequent substance use or SUD.**

Study and location Reference	Participants <sup>2</sup> and setting, age at baseline	Follow-up	Childhood psychopathology instruments and informants	Other measures	Data collection and measures of substance use/abuse
<b>High-risk family studies</b>					
<b>Center for Education and Drug Abuse Research (CEDAR)</b> United States E.g. Tarter. 1995 Tarter et al. 2004 Chapman. 2007 Tarter et al. 2007	10-12-year-old children of fathers with histories of drug - use disorders and children at low risk (53%), having fathers without SUDs or other major adulthood mental disorders.  N=560 (425 boys). Recruiting ongoing. Attrition at baseline not adequately reported.	1989-ongoing Assessments at age 12-14, 16, 19, and annually thereafter until age 30  Total attrition not adequately reported	Diagnostic interview (SADS); mother  Neuropsychological testing Neurobehavioural disinhibition	Parental substance use and psychopathology. Parenting practices. Quality of family, peer, and neighborhood environments. Child's P300 component of the event-related potential.	Age 19: Breath alcohol and urine drug screens, self-reported alcohol and drug use, age at first use, age when regular use began, AUD, DUD diagnoses (diagnostic interview)

<sup>1</sup> Studies with children aged 12 years or younger at baseline, at least 5-year follow-up, and with more than 500 participants were included.

<sup>2</sup> Number of boys and attrition at baseline are reported if information was available in the original publications.

**Abbreviations:** AUD=alcohol use disorder, CAAP=Child and Adolescent Adjustment Profile, CAPA =The Child and Adolescent Psychiatric Assessment, CBCL= child behaviour checklist , CCQ=California Child Questionnaire, CESDS=Center for Epidemiological Studies-Depression Scale, CIDI=composite international diagnostic interview, DICA-R=Diagnostic Interview for Children and Adolescents-Revised, DIS=Diagnostic Interview Schedule, DISC=Diagnostic Interview Schedule for Children, DUD=drug use disorder, FHQ=Family History Questionnaire, IQ=Intelligence quotient, Mm-MAST=Malmö-modified Michigan Alcoholism Screening Test, MFO= Mood and Feelings Questionnaire, MPNI=Multidimensional Peer Nomination Inventory, ND= Nicotine dependence, PBQ=Preschool Behavior Questionnaire, PH=Piers-Harris Children's Self-Concept Scale, RAPI=Rutgers Alcohol Problem Index, RYDS=Revised Yale Developmental Schedules, SADS=Schedule for Affective Disorders and Schizophrenia for School-Age Children, SCID= Structured Clinical Interview for DSM Disorders, SBCL=Simmons Behavior Checklist, SUD=Substance use disorder, TOCA=Teacher's Observation of Classroom Adaptation, YSR=Youth Self-Report

## 2.4.1 Childhood psychopathology

### What is known?

- Childhood externalizing disorders are risk factors for earlier initiation of substance use and substance-use-related problems later in life.

### What is not known?

- The evidence of ADHD symptoms predicting substance use has been equivocal and needs further clarification.
- Knowledge about childhood depression and anxiety and subsequent substance use is scarce, and previous studies have provided mixed results.
- Very little is known about the association between comorbid patterns of childhood psychopathology and subsequent substance use.

### 2.4.1.1 Externalizing disorders

**Childhood externalizing / disruptive behaviour disorders** include **conduct disorder (CD)**, **oppositional defiant disorder (ODD)** and **attention deficit disorder (ADHD)**. Conduct disorder is defined as a persistent pattern of antisocial behaviours in which the basic rights of others, or societal norms or rules, are violated. Possible symptoms are over-aggressive behaviour, bullying, physical aggression, cruel behaviour toward people and pets, destructive behaviour, lying, truancy, vandalism, and stealing. The DSM-IV specifies childhood-onset and adolescent-onset types of CD and different degrees of severity of the disorder (APA, 1994). Oppositional defiant disorder is a pattern of negativistic, hostile, and defiant behaviour including often losing one's temper, arguing with adults, actively defying or refusing to comply with adults' requests or rules, deliberately annoying people, blaming others for his or her mistakes or misbehaviour, being touchy or easily annoyed by others, being angry and resentful, or spiteful or vindictive (APA 1994). Both CD and ODD symptoms are often capitalized as conduct problems.

Serious antisocial behaviours have remarkable developmental stability and these behaviours often persist from childhood to adulthood (Fergusson et al. 2005a, Sourander et al. 2005). Prospective studies have shown that childhood conduct problems increase susceptibility to later substance use, earlier initiation of substance use, and later substance abuse and dependence (Kellam et al. 1980, Boyle et al. 1993, Fergusson et al. 1995, Costello et al. 1999, Loeber et al. 1999, King et al. 2004). It has been suggested that ODD may not increase the risk of substance use in the absence of CD (Costello et al. 1999). Childhood CD, in turn, has been found to, independently of other confounding factors, predict adolescent cigarette smoking and nicotine dependence (Upadhyaya et al. 2002); alcohol use and AUD; and use of cannabis and other illicit drugs, and SUDs (Armstrong and Costello 2002). Both childhood and adolescent conduct problems have been reported to increase the risk of longer-term substance use, and SUD (Fergusson et al. 2007a). However, Sung et al. (2004) found that CD by age 13 greatly increased the risk of SUD in early adolescence, whereas CD occurring later in adolescence had much less effect as a predictor of substance use. Furthermore, particularly children with life-course persistent conduct disturbances are an at-risk group for a wide range of later adverse outcomes, including criminality, mental health problems, suicidality, poorer somatic health, and later academic failure (Fergusson et al. 2005b, Odgers et al. 2007). One must also take into account that not all children with CD develop SUD, and not all young adults with SUD were conduct-disordered as children.



**Attention deficit/hyperactivity disorder (ADHD)** typically presents during childhood, and it is characterized by a persistent pattern of inattention and/or hyperactivity, as well as forgetfulness, poor impulse control or impulsivity, and distractibility (APA 1994). Individuals seeking treatment for substance abuse or dependence retrospectively report higher rates of ADHD in childhood than in the general population (Lynskey and Hall. 2001). Also, follow-up studies of ADHD children have shown a higher incidence of subsequent substance use and SUDs (Biederman et al. 2006, Molina et al. 2007, Elkins et al. 2007). However, in population-based prospective studies, the findings between ADHD and subsequent substance have been equivocal. Quite weak predictive associations have been reported between ADHD and SUD once the strong comorbidity with CD has been controlled for (Costello et al. 1999, Disney et al. 1999, Lynskey and Fergusson 1995, Lynskey and Hall 2001). Some investigators have suggested that ADHD is not an independent risk factor for substance-use outcomes, but only when accompanied with high levels of CD symptoms (Fergusson et al. 2007a, Lynskey and Hall 2001).

**Low inhibitory control** is described as irritability, reactive aggression, impulsivity, and sensation seeking. Massé and Tremblay (1997) have reported that high novelty seeking and low harm avoidance measured at ages 6 and 10 predict onset of cigarette smoking, drunkenness, and other drug use in adolescence. In high-risk studies, e.g. longitudinal studies of offspring of alcoholics, neurobehavioural disinhibition has been suggested as a risk factor, not only for early initiation of substance use (Tarter et al. 1995, Tarter et al. 2003) and SUD (Tarter et al. 2004a), but also for suicidality (Tarter et al. 2004b). Chapman et al. (2007) have reported that paternal SUD and the interaction between maternal SUD and alcohol consumption during pregnancy predicted child's neurobehaviour disinhibition score. In that study, the child's neurobehaviour disinhibition at 10 to 12 years of age, in turn, was found to be a significant predictor of SUD at age 19.

#### 2.4.1.2 *Internalizing disorders*

**Childhood internalizing disorders** include emotional disorders such as depression and anxiety disorders, and often these disorders overlap (Angold et al. 1999). So far, knowledge about childhood emotional problems and subsequent substance use is scarce. The few existing studies that have examined the predictive relation between childhood emotional problems and substance use in adolescence have provided mixed results (Armstrong and Costello 2002). Some of the studies have promoted the “*self-medication hypothesis*”, suggesting that the pharmacological and/or psychological effects of alcohol and some drugs serve to decrease aversive anxiety or depressive symptoms, thereby promoting persistent and escalating use via negative reinforcement (Kushner et al. 2000).

**Depression and depressive symptoms** during childhood have been found to predict subsequent substance use, but so far, the findings have been contradictory. In the Dunedin Study, depressive symptoms at age 11 were found to predict multiple drug use at age 15 among boys, but not among girls (Henry et al. 1993). In that study, both conduct problems and depressive symptoms at age 15 were found to be associated with concurrent substance use, suggesting a sex-specific pathway from early depressive symptoms to subsequent substance use. Costello et al. (1999) indicated that the effect of depression on initiation of substance use and SUD was stronger for boys than girls. In their later report, both anxiety and conduct disorder s were found to predict onset of substance abuse, while major depression, ADHD, and ODD did not (Costello et al. 2003). On the other hand, Silberg et al. (2003) reported in their twin study that depressive symptoms associate more strongly with substance use in girls than in boys. Depressiveness may also concur with low self-esteem, which has also been found to anticipate later substance use (Tarter et al. 2007).

**Anxiety disorders** include a variety of disorders, e.g. separation anxiety, specific phobias, generalized anxiety disorder, panic disorder and posttraumatic stress disorder (PTSD). Anxiety spectrum symptoms include, e.g. shyness, withdrawal, and fearfulness. In terms of specific childhood anxiety disorders, Kaplow et al. (2001) indicated two contradictory processes: children with generalized anxiety disorder were more likely to use alcohol and did so at an earlier age than other children, whereas children with separation anxiety disorder were less likely to use alcohol and began later. In that study, overall anxiety symptomatology did not predict initiation of alcohol use while controlling for depression. Another study from the same cohort indicated that children with an anxiety disorder began smoking cigarettes later than children without an anxiety disorder (Costello et al. 1999). In the Dunedin Study, the 3-year-old boys rated as behaviourally inhibited (i.e. shy, fearful and easily upset) were found to be significantly more likely to report alcohol dependence at age 21 (Caspi et al. 1996). On the contrary, the results from the Woodlawn Project showed that, among boys, childhood shyness reduced the risk of substance use problems in adulthood (Crum et al. 2006). In addition, the findings from the Pittsburgh Youth Study have indicated that the least common substance users were those who manifested persistent internalizing problems only (Loeber et al. 1999).

#### 2.4.1.3 Comorbidity

The heterogeneity of the problems raises taxonomic questions about the boundaries between different kinds of problems, many of which occur together in varying combinations. Comorbidity constitutes one of the most perplexing problems faced by taxonomists, epidemiologists, and psychopathologists today. Comorbidity centres on the co-occurrence of two (or more) different diseases or disorders (Angold et al. 1999). Cohen et al. (1993) have indicated that the average number of childhood psychiatric disorders was 1.7 among children 10–13 years of age. A higher level of childhood psychopathologic comorbidity has been suggested to be more common among boys compared to girls (Somersalo et al. 1999), but also findings with no such gender difference have been reported (Cohen et al. 1993). The highest levels of comorbidity have been found between disruptive behaviour disorders and ADHD, and anxiety disorders and depression (Angold et al. 1999). Although Angold et al. (1999) found the lowest levels of comorbidity between anxiety and disruptive behaviour disorders, these disorders frequently co-occur (Bird et al. 1993). Compared with pure and non-disordered cases, comorbid cases have shown generally more adverse outcomes in later life, including a more chronic course of psychiatric illness (Newman et al. 1998), and suicidality (Foley et al. 2006). However, there is no consensus as to the optimal way to operationalize comorbidity, and there is controversy about whether comorbid anxiety disorders signal a more benign or malignant form of conduct disorder (Graham and Rutter 1973, Lalongo et al. 1996).

In spite of the clinical importance of comorbid psychiatric symptomatology, there is only little literature about childhood comorbidity as a risk factor for later substance use (Kellam et al. 1980, Loeber et al. 1999, Armstrong and Costello 2002, Fothergill and Ensminger 2006). Goodwin et al. (1975) showed in their adoptee study that the alcoholics as children were more often hyperactive, truanting, antisocial, shy, aggressive, disobedient, and friendless. In the Woodlawn study, boys rated as both shy and aggressive have been found to demonstrate the heaviest use of cigarettes, alcohol and cannabis at follow-up as adults (Ensminger et al. 2002). Loeber et al. (1999) have shown that the mixed type of psychopathology (persistent substance use with persistent delinquency and internalizing problems, with or without ADHD) associates with substance use particularly at a younger age.

## 2.4.2 Intelligence and school performance

A declining childhood intelligence quotient (IQ) has been found to associate with a range of adverse outcomes in later life: substance use behaviours, increased rates of crime, mental health problems, sexual behaviours and early pregnancy (Fergusson et al. 2005a). However, when adjusted for the effects of correlated conduct problems and social background, declining IQ was associated only with nicotine dependence (Fergusson et al. 2005a). In the Woodlawn project, higher scores on IQ and readiness-for-school tests at age six were found to associate with higher levels of beer or wine, hard liquor, and marijuana use in adolescence, and this was evident for both sexes (Kellam et al. 1980). When followed up to adulthood, underachievement at age six was found to predict AUD and drug use in mid-adulthood (Crum et al. 2006, Fothergill et al. 2007). In addition, low math scores in adolescence, suspension from and skipping school in adolescence, and not having a high school diploma were related to drug use as adults (Fothergill et al. 2007). One must note that much of the association between early intelligence and later substance use is most probably mediated by childhood conduct problems and family social circumstances, or other factors (Fergusson et al. 2005b). For instance, several researchers (e.g. Johnson and Leff 1999, Poon 2000) have reported lowered academic functioning in children of alcoholics.

## 2.4.3 Family background

Several childhood environmental factors have been identified as risk factors for substance use and SUDs. **Family history of substance use** has been found to predict an offspring's earlier onset of alcohol use independently of the child's psychiatric disorder, and other familial risk factors, such as family poverty, parenting style, parental psychiatric problems, and traumatic life events (Costello et al. 1999). However, Kuperman et al. (2005) have found in their high-risk study of sons of alcoholics, that child and environmental factors were stronger predictors of age of first drink than family history of psychopathology and substance use. The relationship between **parental substance use** and subsequent substance-use-related problems in their children has been documented extensively (see, e.g. Fergusson et al. 2007b, Habeych et al. 2005, Johnson and Leff 1999, Lieb et al. 2002, Peiponen et al. 2006). Substance use behaviours of both the mother and the father influence the substance-use behaviour of their offspring. In a Finnish study, current heavy drinking of the father as well as parental drinking during the earlier childhood years were found to predict problematic alcohol use in their children at the age of 15 (Seljamo et al. 2006). Family substance use may facilitate a child's substance use in several ways. One of them is parental or sibling role modelling of antisocial values and substance-use behaviours. Parental substance use may increase the likelihood of future maladaptation and can be environmental (e.g. low socioeconomic status, family conflict and marital discord with verbal, physical or sexual abuse), biologic (e.g. inheritance of a gene predisposing toward SUD), or psychological (e.g. low self-esteem) (Johnson and Leff 1999). In addition, **sibling substance use** may increase the likelihood of substance use by younger children (Bricker et al. 2007, Brook et al. 1990).

**Maternal substance use during pregnancy** has also been found to increase the risk of offspring's drug and alcohol abuse, and smoking (Al Mamun et al. 2006, Alati et al. 2006). Preliminary findings from animal studies suggest that early exposure to substance use may alter offspring's brain reward system, and males may be potentially more vulnerable to these effects compared to females (Malanga et al. 2007). Prenatal exposure to substance use has also been found to associate with offspring's antisocial behaviour (Räsänen et al. 1999a, Fergusson et al.

1998, Weissman et al. 1999), ADHD (Milberger et al. 1996), and possibly with depression (Fergusson et al. 1998, Slotkin et al. 2006). Therefore, early exposure to substance use may have direct and indirect effects to offspring's vulnerability on substance-use-related problems.

**Parental psychopathology** poses an additional developmental risk for children. For instance, children of depressed and antisocial mothers have been found to be at risk of childhood maltreatment (Kim-Cohen et al. 2006a). Furthermore, mother's psychopathology may increase the risk of offspring's conduct disorder (Kim-Cohen et al. 2006a). Also **adverse childhood experiences**, such as sexual abuse or domestic violence have detrimental impacts on child development, and can contribute to later substance use (Fergusson et al. 1996, Ilomäki et al. 2007, Ompad et al. 2005).

**Parental practices**, e.g. lack of parental bonding and early insecure attachment, inconsistent discipline, and parental failure to monitor the child's activities have also been associated with offspring's substance use (Latendresse et al. 2008). It has been stated that parental child-rearing practices and clear rules towards substance use may serve as protective factors towards adolescent substance use (Brook et al. 2001, van der Vorst et al. 2006). Findings from animal studies have supported the importance of early attachment. In rats, maternal deprivation in pups has been found to lead to a basal hypoactivity of the enkephalinergic system and hypersensitivity to morphine effects as adults (Vazquez et al. 2005). Accordingly, postnatal environment change may lead to hypersensitivity to the reinforcing properties of morphine and to the development of dependency (Vazquez et al. 2005). Findings from a high risk study have indicated that a difficult temperament places the child at risk of maltreatment by parents and of development of a disruptive behaviour disorder (Blackson et al. 1996). Accordingly, the causal associations between childhood psychopathology, environmental factors and subsequent problem behaviours are complex.

**Childhood family structure** has been found to associate with later substance-use-related problems. Children of lone parents have been found to be at elevated risk of later substance-use-related problems compared to children of two-parent families (O'Connor et al. 2001, Weitoft et al. 2003). However, Fergusson et al. (2007c) have concluded that the associations between exposure to single parenthood in childhood and outcomes in early adulthood may be explained by the social and contextual factors that are associated with exposure to single parenthood, not single parenting *per se*. Lone parents may be exposed to financial hardship, causing anxiety, depression, and social isolation, which in turn may lead to maladaptive coping strategies, including excessive substance use. In addition, marital changes and parental separation during childhood have been found to predict substance use of the offspring (Fergusson et al. 1994b Hayatbakhsh et al. 2006, Seljamo et al. 2006). Particularly, complex stepfamilies have been found to associate with elevated levels of childhood psychopathology (O'Connor et al. 2001). There, the association between childhood psychopathology and family structure was mostly explained by the quality of the parent-child relationship, parental depression and socio-economic disadvantage (O'Connor et al. 2001). Furthermore, rather than family structure or the quality of relationships, childhood conduct problems have been shown to predict later substance use (Nicholson et al. 1999).

**Socio-economic status (SES)** describes a person's position in society using criteria such as income, level of education, occupation, and value of property owned (Galobardes et al. a 2006). Being raised in a family characterized by low SES has been found to contribute to child's subsequent substance use, particularly cigarette smoking (Fergusson et al. 2007b, Goodman and Huang. 2002). However, a recent meta-analysis showed only little evidence to support the association between childhood SES and later alcohol use (Wiles et al. 2007). Many of the known

risk factors for substance use accumulate in low SES families, and the direct effect of low SES can be questioned (Wiles et al. 2007, Fergusson et al. 2007b). Particularly when combined with a broader range of family disadvantages, e.g. parental substance use and mental health problems, low familial SES can be related to inter-generational disadvantage and associated negative outcomes. In addition, a lower occurrence of substance use in later life has been associated with low parental SES, suggesting that familial monetary income may have an effect on accessibility to substances (Fothergill and Ensminger 2006, Johansen et al. 2006). In regard to child psychopathology, Costello et al. (2003) have suggested a social causation explanation of poverty for conduct and oppositional disorder, but not for anxiety or depression.

#### 2.4.4 Resiliency factors

It must be noticed that not all children of substance-using or psychiatrically ill parents or living in an impoverished environment develop substance-use-related problems. Some individuals, despite being faced with the most pernicious of adversities, manage to avoid psychological collapse and to maintain healthy adjustment (Johnson and Leff 1999, Kim-Cohen et al. 2004). **Resilience** has been conceptualized as a “process encompassing positive adaptation within the context of significant adversity” (Kim-Cohen et al. 2004). Resiliency or protective factors (see also **Figure 2**, page 12) include individual characteristics such as higher intelligence, and more effective neuropsychological response inhibition (Nigg et al. 2007). Of temperament characteristics, a good-natured, sociable temperament has been observed among young children resilient to SES adversity, and has been found to help moderate the effects of stress on children’s behavioural problems (Kim-Cohen et al. 2004).

#### 2.4.5 Genetic factors

Although it is not within the scope of the present thesis, it is meaningful to also include a short review of **genetic factors** and substance use. Compared to experimenting and moderate levels of substance use, heavier patterns of substance use and SUD may be determined to a significant degree by genetic factors, while environmental factors may contribute more to less problematic levels of substance use (Maes et al. 1999, Rhee et al. 2003). Results from high-risk and twin studies show familial aggregation of SUDs as an indication of heritability (Johnson and Leff. 1999, Malone et al. 2002, Kendler et al. 2003). However, there is a substantial overlap in the genetic liability for antisocial behaviour and substance use problems, as well as for temperamental features, disinhibitory psychopathology and attention deficit/ hyperactivity disorder (Keyes et al. 2007, Rutter et al. 2006b). For instance, problem behaviours, such as physical aggression, oppositional and hyperactive behaviour in sons of male alcoholics have been found to begin early and persist over time (Carbonneau et al. 1998). Genetic susceptibility may also influence the psychophysiological response to particular substances (Schuckit et al. 2005, Rutter et al. 2006b, Hinckers et al. 2006), e.g. liking the drug, which in turn, has been found to increase the risk of later SUD (Fergusson et al. 2003a). On the other hand, Kendler et al. (2003) have stated that the environmental experiences, more than genetic factors largely determine whether predisposed individuals will use or misuse one class of psychoactive substances rather than another.

It has also been assumed that genetic vulnerability to SUDs is likely to be conferred by multiple genes of small to modest effect, possibly only apparent in gene-environment interactions (Enoch 2006). For example, it has been shown that childhood maltreatment interacts with a monoamine oxidase A (MAO-A) gene variant to predict antisocial behaviour that is often associated with alcoholism (Kim-Cohen et al. 2006b). Recently, in a follow-up study of maltreated children and

their controls, early alcohol use was found to be predicted by childhood maltreatment, a certain serotonin transporter genotype, and a gene by environment interaction (Kaufman et al. 2007).

Certain genotype and neurobiological factors may also act as a resilience indicator against adverse development. For instance, Nigg et al. (2007) have suggested that a certain genotype may act as a resilience indicator against development of ADHD and CD, but not ODD. These preliminary findings also illustrated potential neurobiological protective factors related to the development of prefrontal cortex that may enable children to avoid developing ADHD and CD in the presence of psychosocial adversity. Hopfer et al. (2006), in turn, have indicated that a common central cannabinoid receptor haplotype (CNRI) associates with developing fewer cannabis-dependence symptoms among adolescents who have experimented with cannabis. In conclusion, it is likely that a complex mix of gene-environment interactions underlie addiction vulnerability and development of SUD (Enoch 2006, Rutter et al. 2006b).

#### **2.4.6 Gender differences**

Generally, substance use is more common among males, and boys begin to use substances earlier than girls (Brady and Randall 1999). However, at puberty (age 12 to 17 years), substance use has been found to be as common among girls as among boys (Rimpelä et al. 2005). Early pubertal maturation has been found to predict alcohol use in both sexes, but AUD only in girls (Costello et al. 2007). Substance use among girls is strongly influenced by substance using boyfriends (Brady and Randall 1999). Girls have also been reported to have a significantly higher prevalence of comorbid psychiatric disorders, such as depression and anxiety, than boys, and these disorders may predate the onset of substance-abuse problems (Brady and Randall 1999). In a Finnish study, heavy drinking was found to be associated with more severe psychosocial dysfunction among 15-year-old girls than boys (Laukkanen et al. 2001).

In many available prospective studies, the gender differences on studied risk factors have not been specified. This may reflect the limited number of large-scale longitudinal child psychiatric studies, but also the preponderance of externalizing disorders among boys. For instance, many of the ADHD and conduct disorder studies are based on clinic-referred samples, and have included solely samples of males or they have had an over-representation of males (Lynskey and Hall 2001, Tremblay et al. 1992, Tarter et al. 1995, Loeber et al. 1999). However, ADHD and CD do occur among girls as well, and externalizing problems have been recognized to predict substance use initiation and abuse in both genders (Elkins et al. 2007).

**A summary of the findings from the selected prospective studies including data on childhood psychopathology (before age 12) is presented in Table 3 (alcohol), Table 4 (smoking), and Table 5 (illicit drugs).**

**Table 3. Childhood predictors for alcohol use or alcohol use disorder (AUD). Summary of findings from selected longitudinal population studies.**

Author, location	Sample (attrition at follow-up)	Follow-up (age, years)	Outcome measure of alcohol use or AUD	Findings/Comment
Henry et al. 1993 New Zealand	956 (8%)	11 to 15 years	Alcohol use more than 3 times during the past 12 months; or drinking at school	Conduct problems and depressive symptoms at age 11 did not predict alcohol use at age 15. No separate analyses were performed for boys and girls.
Caspi et al. 1996 New Zealand	961 (7%)	3 to 21 years	Self-reported problems related to the use of alcohol, AD in the last 12 months	Under-controlled (e.g. impulsive, restless, distractible) as well as inhibited (e.g. fearful and limited communication), behaviour at age 3 predicted AD only among boys.
Fergusson et al. 2007a New Zealand	973 (23%)	7-9 to 18-25 years	The frequency of alcohol consumption and the amounts consumed within the previous 12 months, and AUDs	Childhood conduct problems with increasing levels predicted AUDs, but not alcohol use. Attentional problems did not predict later alcohol outcomes after adjusting for conduct problems and other variables. No separate analyses were performed for boys and girls.
Ferdinand et al. 2001 Netherlands	487 (38%)	10-14 to 19-23 years	Number of drinks per week in the past 6 months	Thought problems at age 12-16 and delinquent behaviour at age 14-18 years predicted alcohol use at age 19-23. Male gender associated with alcohol use at all time points.
Kellam et al. 1980 United States	939 (25%)	6 to 16 years	Frequency of lifetime alcohol use and quality of alcohol.	Aggressive behaviour rated by their teachers predicted use of alcohol and drugs. Also boys who were rated by their teachers as shy and aggressive were more likely to use drugs and alcohol 10 years later.
Brook et al. 1998 United States	698 (28%)	1-10 to 18-27 years	Self-reported alcohol use frequency	Psychiatric disorders did not predict subsequent alcohol use. Alcohol use predicted APD and anxiety disorders. No separate analyses were performed for boys and girls.
Hill et al. 2000 United States	755 (6%)	10-12 years to 21 years	Binge drinking frequency during the past month, AUD at age 21	Binge drinking in adolescence predicted AUD. Externalizing and internalizing problems and delinquency at age 10-12 were most common among the early-onset binge drinkers. No separate analyses were performed for boys and girls.
Guo et al. 2001 United States	755 (6%)	10-12 to 21 years	AUD at age 21	Childhood and adolescent antisocial behaviours predicted AUD. Strong bonding to school, close parental monitoring of children and clearly defined family rules for behaviour, appropriate parental rewards for good behaviours, high level of refusal skills and strong belief in the moral order predicted a lower risk of AUD. Male gender predicted AUD.

**Abbreviations:** AD=alcohol dependence; APD=antisocial personality disorder; AUD=alcohol use disorder

**Table 3 (continued). Childhood predictors for alcohol use or alcohol use disorder (AUD). Summary of findings from selected longitudinal population studies.**

Author, location	Sample (attrition at follow-up)	Follow-up (age, years)	Outcome measure of alcohol use or AUD	Findings/Comment
Kaplow et al. 2001 United States	936 (34%) (Average attrition across waves 8%)	9,11,13 years to 13,15,17 years	Ever had a drink of alcohol (not just a sip) without parental permission	GAD increased risk and separation anxiety decreased risk of alcohol initiation. Depressive symptoms increased risk of alcohol use initiation. No gender differences were detected.
Sung et al. 2004 United States	1420 (average attrition across waves 8%)	9,11,13 years annually to 16 years	Any use, ever and in the last 3 months, of tobacco, alcohol without adult permission, and other substances. first use, frequency, quantity, and associated impairment, SUD	Boys had earlier onset of alcohol use. Early use predicted SUD even in the absence of CD. CD had a strong additive effect at ages 13-15, but at age 16, the excess risk from prior CD decreased. Depression predicted SUD among boys, but not among girls. Anxiety increased the risk of SUD in girls at age 16, but not before that.
Costello et al. 2007 United States	1420 (average attrition across waves 8%)	9,11,13 years, assessment annually until 16 years	Lifetime AUD, alcohol use without parental permission within past 3 months	Early pubertal maturation predicted alcohol use in both sexes, and AUD in girls. The highest level of excess risk for alcohol use was seen in early maturing youth with conduct disorder and deviant peers.
King et al. 2004 United States	1364 (3%)	10-11 to 13-14 years	Life-time alcohol use and heavy use; alcohol use and heavy use during the past 12 month	First time use after age 11 predicted alcohol use at age 14 among boys only. CD and ODD increased risk of first time use at age 11, and regular alcohol use at age 14. Effect of externalizing disorders on heavy drinking was more evident among boys. Internalizing disorders and ADHD did not predict alcohol use.
Wu et al. 2006 Puerto Rico	1119 (12%)	10-13 to 14-17 years	Lifetime and past-year alcohol use, AUD	Childhood depressive symptom predicted subsequent alcohol use initiation. Children with medium or high levels of depressive symptoms were more likely to use alcohol than those with less than two depressive symptoms. No gender differences were detected.

**Abbreviations:** AD=alcohol dependence; APD=antisocial personality disorder; AUD=alcohol use disorder; CD=conduct disorder; MDD= major depressive disorder; ODD=oppositional defiant disorder; DISC=Diagnostic Interview Schedule for Children



**Table 4. Childhood predictors for smoking or nicotine dependence (ND).  
Summary of findings from selected longitudinal population studies.**

Author, location	Sample (attrition at follow-up)	Follow-up (age, years)	Measure of smoking or ND	Findings/Comment
Fergusson et al. 1995 New Zealand	735 (42%)	8 to 16	Age of onset of smoking experimentation up to the age of 13 years Age 14 and 16: extent of cigarette smoking by the young person in the last 12 months.	Common social, individual (childhood conduct problems) and contextual factors were associated with both smoking experimentation and later smoking. Peer affiliations at age 15 years and smoking experimentation prior to age 13 years associated with cigarette smoking at age 16, even after controlling for conduct problems and familial smoking. No separate analyses were performed for boys and girls.
Ferdinand et al. 2001 Netherlands	487 (38%)	10-14 to 19-23	Number of cigarettes per day in the past 6 months	Thought problems at age 10-14 and 14-18 years, aggressive behaviour at age 12-16 years, and delinquent behaviour at age 14-18 years predicted cigarette smoking at age 19-23 years. No separate analyses were performed for boys and girls.
Brook et al. 1998 United States	975 (28%)	1-10 to 18-27	Self-reported cigarette smoking frequency during the past year	CD did not predict cigarette smoking. Smoking predicted APD, MDD and anxiety disorders. No separate analyses were performed for boys and girls.
Wu and Anthony 1999 United States	1731 (19%)	8-9 to 13-14	Initiation of smoking	Smoking increased risk of depressed mood, but not vice versa. A school-based intervention study with a follow-up. Those with childhood smoking were excluded from the study.
Juon et al. 2002 United States	952 (23%)	6 to 32 years	Initiation, continuation, and cessation of cigarette smoking between adolescence and early adulthood	Current smokers were more likely to be rated as aggressive or both shy and aggressive at age 6, and to have drug problems as adults. Gender, mother's smoking and mother's lifetime depression were not related to smoking.
King et al. 2004 United States	1364 (3%)	10-12 to 13-14	Life-time use; regular use; and daily use of cigarettes during the past 12 months	CD, ODD and ADHD at age 11 increased the risk of experimenting and regular use of cigarettes at age 14. MDD increased the risk of first-time cigarette use at age 11, but not regular or daily use. Externalizing disorders predicted nicotine use for both genders
Burke et al. 2007 United States	2 age cohorts: (age 7 at baseline n=503; age 13 at baseline n=506)	7 / 13 years to 20 / 25 years	Number of days of use of tobacco during the past 6 or 12 months, tobacco dependence in early adulthood	Inattention, but not hyperactivity-impulsivity, predicted adolescent tobacco use and young adult daily tobacco use. Peer and parental substance use and conduct disorder predicted increases in tobacco use.

**Abbreviations:** ADHD=attention deficit/hyperactivity disorder, APD=antisocial personality disorder, CD=conduct disorder, MDD= major depressive disorder, ND=nicotine dependence, ODD=oppositional defiant disorder

**Table 5. Childhood predictors for illicit drug use or drug use disorder (DUD). Summary of findings from selected longitudinal population studies.**

Author, location	Sample (attrition at follow-up)	Follow-up period (age, years)	Measure of drug use/DUD at follow-up	Findings/conclusions
Fergusson and Horwood 1997 New Zealand	945 (24%)	8 to 18 years	Cannabis use at age 15-16 within past 12 months (no use, use less than 10 occasions, 10 or more occasions)	Conduct problems at age eight, social disadvantage, and adverse peer affiliations in adolescence predicted early onset cannabis use. Early onset users had significantly higher rates of later substance use, juvenile offending, mental health problems, unemployment and school dropout, affiliations with delinquent and substance-using peers, moving away from home and dropping out of education
McGee et al. 2000 New Zealand	948 (9%)	5 to 15, 18, and 21 years	Age 15: frequency of cannabis use within the past year. Age 18 and 21: frequency of cannabis use, and cannabis dependence within the past year.	Childhood behavioural problems and socioeconomic disadvantage predicted subsequent cannabis use. Cross-sectional associations between cannabis use and mental disorder were significant at all three ages (15, 18, and 21 years). No separate analyses were performed for boys and girls.
Ferdinand, et al. 2001 Netherlands	487 (38%)	10-14 to 19-23	Self-reported drug use frequency in the past 6 months	Delinquent behaviour at age 10-14 and 12-16 years predicted drug use at age 19-23 years. No separate analyses were performed for boys and girls.
Huizink et al. 2006 Netherlands	1580 (24%)	4-17 to 18-31 years	Lifetime use of MDMA (at least 5 occasions)	Individuals with childhood symptoms of anxiety and depression predicted subsequent MDMA use. No separate analyses were performed for boys and girls.
Alati et al. 2008 Australia	2551 (not reported)	5 to 14 to 21 years	Lifetime use of MDMA (at least 5 occasions)	Delinquent and aggressive behaviour at age 5 and 14 predicted MDMA use at age 21. These associations became statistically non-significant when adolescent tobacco and alcohol use were included in the model. No separate analyses were performed for boys and girls.
Brook et al. 1995 United States	397 (21%)	5-10 years, follow-up at age 13 -18 and 16-21 years	Frequency of illicit drug use	Childhood aggression predicted drug use at 16 to 21 years, but the effects were mediated through intrapsychic distress and unconventionality. No separate analyses were performed for boys and girls.
Brook et al. 2000a United States	532 (31%)	7-16 to 21-30	Self-reported drug use frequency	Unconventionality (rebelliousness, lesser responsibility, and tolerance of deviance) associated with drug use and drug-using peers. Adolescent conventionality associated with non-deviant peers protecting the adolescent from drug use.

**Abbreviations:** DUD=drug use disorder, MDMA=3,4-methylenedioxymetamphetamine

**Table 5 (continued). Childhood predictors for illicit drug use or drug use disorder (DUD). Summary of findings from selected longitudinal population studies.**

Author, location	Sample (attrition at follow-up)	Follow-up period (age, years)	Measure of drug use/DUD at follow-up	Findings/conclusions
Brook et al. 2000b United States	532 (31%)	7-16 to 21-30	Self-reported marijuana use frequency in the past year.	Unconventionality associated with initial cannabis use. Unconventionality did impact on the overall growth rate of cannabis use between early adolescence and the late twenties.
Reinherz et al. 2000 United States	360 (28%)	5 to 21	Lifetime DUD at age 21	Larger family size, lower socioeconomic status, hyperactivity, attention problems, and aggression predicted DUD at age 21. Parental substance abuse and having younger parents were specific risk factors for drug disorders in boys. Separate pathways for DUD and depression were suggested.
White et al. 2001 United States	500 (6.4%)	Annually from 13-18 to 19-23	Frequency of cannabis use during the past year at ages 13, 14, 15, 16, 17, and 18.	Higher levels of ADHD, conduct disorder, and violence predicted higher levels of cannabis and alcohol use. Sample included only boys.
Guo et al. 2002 United States	808 (23%)	12 to 21	Use of illicit drug, assessed at ages 12 to 18, and age 21	Poor family monitoring and bonding, family conflict, and peers' antisocial activity predicted illicit drug initiation. No separate analyses were performed for boys and girls.
Ensminger et al. 2002 United States	952 (23%)	6 to 32 years	Current and lifetime use of illicit drugs (marijuana and cocaine)	Childhood aggressive behaviour predicted drug use as adults for both genders. Males with comorbid shy and aggressive behaviour were at greatest risk of later drug use. Shy girls were less likely to use drug as adults.
King et al. 2004 United States	1364 (3%)	10-12 to 13-14	Lifetime use of cannabis, use during the past 12 months, any symptom of cannabis abuse or dependence (experienced use)	CD and ODD increased risk of first time use at age 11, regular use, and experienced cannabis use at age 14. Externalizing disorders predicted cannabis use for both genders.

**Abbreviations:** ADHD= attention deficit/hyperactivity disorder, CD=conduct disorder, DUD=drug use disorder, ODD=oppositional defiant disorder

## 2.5 Correlates of substance use at young age

### What is known?

- Substance use associates with many psychosocial adversities at a young age, such as educational and occupational problems, interpersonal and familial conflicts, and proneness to accidents, mental health problems, suicidality and youth crime.

### What is not known?

- Psychosocial correlates of different levels of substance use have been less studied.
- Correlates of substance-use-related crime, i.e. drunk driving and drug offending, have been studied very little.

Compared to other life stages, adolescence may include more risk-taking behaviours, including thrill-seeking, rebelliousness, recklessness and antisocial risk behaviours and substance use (Gullone and Moore 2000). Adolescence begins with the onset of physiologically normal puberty, and ends when an adult identity and behaviour are accepted. The World Health Organization (WHO) defines the 10-19 year-olds as the age group of *adolescents*; the 15-24 year-olds as *youth*; and collectively the 10-24 year-olds as *young people*. In addition, the stages of adolescence have been described as early adolescence (12 to 15), middle adolescence (15 to 18), and late adolescence (18 to early 20s) (WHO 2008). The period from 18 to 25 years has been defined as a period of emerging adulthood, considered as a distinct developmental period characterized by change and exploration of possible life directions (Arnett 2000). However, adolescence is a fluid concept, and there is no societal agreement in Western culture as to the age at which an individual ceases to be a child, or ceases to be an adolescent and becomes an adult (Blos 1962).

Substance use may have an important influence on the life course of adolescents to the extent that it affects their ability to achieve the developmental milestones of this period, such as the acquisition of key academic skills, the establishment of positive peer relations, and the formation of a strong self-concept (Ellickson et al. 2003). In previous research, substance use has been found to relate to several adverse outcomes, such as mental health problems, suicidality (Esposito-Smythers and Spirito 2004), educational and occupational problems (Ellickson et al. 2003, Wells et al. 2004), interpersonal and familial conflicts, sexual risk-taking (Bonomo et al. 2001), proneness to accidents (Hingson 2006, Maio et al. 1994, Bonomo et al. 2001), and youth crime, especially violent offending (Ellickson et al. 2003, Wells et al. 2004).

### 2.5.1 Comorbid psychopathology

SUDs and substance-use-related problems co-occur frequently with psychiatric disorders. In the general population, the prevalence of psychiatric comorbidity among youths with SUD is approximately 60-80% (Armstrong and Costello 2002, Essau et al. 2002). A direct relationship between the number of comorbid disorders and increasing levels of severity of substance use has been indicated, and this association has been found to be stronger for illicit drug use than alcohol use (Merikangas et al. 1998). Among substance-using youths, prevalence rates of externalizing disorders (ADHD and CD) have been found to be higher than prevalence rates of internalizing disorders (mood, anxiety disorders) (Merikangas et al. 1998, Kandel et al. 1999, Armstrong and Costello 2002). Compared to adults, a stronger relationship between current and lifetime SUD, and adolescent MDD has been suggested (Rohde et al. 1991). In the Methods for the Epidemiology of Child and Adolescent Mental disorders (MECA) Study, of those with SUD, 76% had an anxiety, mood or disruptive disorder compared to the 25% of the adolescents

without a SUD diagnosis (Kandel et al. 1999). Of personality disorders, substance use has been found to associate mainly with cluster B (dramatic or erratic behaviour personality disorders (Moran et al. 2006). This was contradicted in a Finnish study, where only Cluster C (anxious or inhibited behaviour) personality disorders associated with SUD (Kantofjärvi et al. 2006).

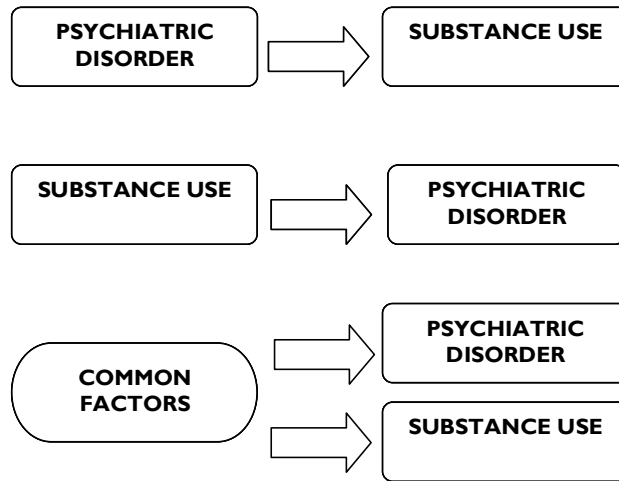
**Suicidal behaviours** are markedly more common among young people with substance-use-related problems compared to youths without these problems (Goldston 2004). However, the relationship between substance use and suicidal behaviour does not occur in isolation; both substance use and suicidality associate with a variety of other health endangering or risk-taking behaviours, e.g. delinquency (Goldston 2004). Foley et al. (2006) have indicated that SUD increases the risk of suicidality only in the presence of multiple psychiatric disorders, and suicidality is always associated with depression. In a Finnish study by Pirkola et al. (1999), 42% of 13-22-year-old suicide victims were classified as having suffered from either AUD or diagnostically subthreshold alcohol misuse according to a retrospective evaluation. Suicide victims with AUD-related problems were more likely to have comorbid psychiatric disorder, antisocial behaviour, disturbed family backgrounds, precipitating life-events as stressors, and severe psychosocial impairment. In addition, they also had a greater tendency to be alcohol-intoxicated at the time of the suicidal act, which tended to occur during weekends, suggesting that drinking in itself, and its weekly pattern, each contributed to the completion of their suicides (Pirkola et al. 1999).

The **causal associations** between substance use and psychopathology are complex, as presented in **Table 6 and in Figure 8**. The presence of SUD also has a substantial effect on psychopathology (Deas 2006). Also here, genetic factors may contribute to the risk of developing a psychiatric disorder. For instance, Caspi et al. (2005) have demonstrated that most vulnerable to later psychotic symptoms were individuals with valine/valine variant of Catechol-O-Methyltransferase (COMT) gene and early-onset cannabis use (<age 14). On the other hand, prospective studies have shown that in all cases of adult psychiatric disorders, a substantial proportion had a history of CD or ODD, and it has been suggested that most adult disorders should be reframed as extensions of juvenile disorders (Arseneault et al. 2003, Kim-Cohen et al. 2003, Rutter et al. 2006a). Also studies using retrospective information about age of onset of mental and substance disorders have consistently suggested that among patients with concurrent psychiatric disorders and SUD, psychiatric disorders typically start at an earlier age than SUDs (Kessler 2004).

**Table 6 and Figure 8 summarize the possibilities to explain observed patterns of mental-substance comorbidity (Kessler 2004, Schuckit 2006).**

**Table 7 summarizes the findings on substance use and psychopathology in early adulthood.**

**Figure 8. Observed patterns of mental-substance comorbidity**



**Table 6. Explanations of observed patterns of mental-substance comorbidity**

**By Kessler (2004)**

1. Mental disorders lead to the onset and/or persistence of substance use disorders, most plausibly through processes that involve increased exposure to substance use (associated largely with conduct disorder), disinhibition to experiment with drugs (associated with impulse-control disorders), and self-medication of dysphoric mood.
2. Substance use disorders lead to the onset and/or persistence of mental disorders, most plausibly through a combination of biological and environmental mechanisms whereby substance disorders cause increased exposure to stress and decreased access to stress-buffering coping resources.
3. There are common causes, either genetic or environmental, that lead to the onset and/or persistence of both types of disorder.
4. Methodological factors involving either sampling, reporting, or measurement might lead to overestimation of comorbidity.

**By Schuckit (2006)**

1. Combinations of SUDs and psychiatric disorders may represent two or more independent conditions, each of which is likely to run the distinct clinical course relatively unique to that disorder. This combination could occur through chance alone (roughly the prevalence of one disorder multiplied by the prevalence of the other), or be a consequence of the actions of the same predisposing factors (e.g. childhood environment and genetic influences)
2. The first disorder could influence the development of the second condition in a such a manner that the additional disorder then runs an independent course.
3. The second condition develops through an effort to diminish problems associated with the first syndrome, reflecting the self-medication hypothesis.
4. Substance-induced syndromes resemble psychiatric syndromes (e.g. stimulant intoxication psychosis with features resembling schizophrenia or depressive syndromes with cessation of alcohol).

**Table 7. Summary of findings from selected<sup>1</sup> birth cohort studies on psychiatric disorders and substance use in late adolescence or early adulthood**

Author, location	Study design	N (males) <sup>2</sup>	Age, years	Measure of substance use	Findings/Comment
<b>Depression/Anxiety</b>					
Fergusson et al. 2003b New Zealand	Longitudinal birth cohort	1061	15-16, 17-18 to 20-21	ND at age 18	MDD was independently associated with daily smoking and ND. No separate analyses were performed for males and females.
Goodwin et al. 2004 New Zealand	Longitudinal birth cohort study	1053	18-21	SUD	Anxiety disorder was unrelated to all measures of substance use after adjustment for confounding factors. No separate analyses were performed for males and females.
Hayatbakhsh et al. 2007 Australia	Longitudinal birth cohort study	3239 (1547)	15 to 21	Occasional or frequent cannabis use	Anxiety or depressive symptoms did not predict cannabis use. Frequent, but not occasional cannabis use predicted anxiety and depressive symptoms. Association was stronger for those with early onset (<14 years) cannabis use. No separate analyses were performed for males and females.
Patton et al. 1998 Australia	Longitudinal community sample	2032	14-15 to 17-18	Cigarette smoking	Depression and anxiety symptoms increased the risk of smoking initiation and transition to daily smoking among boys, but not among girls.
Patton et al. 2002 Australia	Longitudinal community sample	1601 (731)	14-15 to 21-22	Self-reported cannabis use	Frequent cannabis use in teenage girls predicted later depression and anxiety, with daily users carrying the highest risk. Depression and anxiety in teenagers predicted neither later weekly nor daily cannabis use.
Rohde et al. 1991 United States	Cross-sectional community study. Sample of adolescents and adults	1710 and 2060 (adults)	14-18 and adults > 18	SUD	Adolescent depression associated strongly with current and lifetime SUD, and this association was stronger among depressed adolescents than adults. No separate analyses were performed for males and females.
Dierker et al. 2007 United States	Longitudinal community sample, high school students	4838 (2239)	12-18 to 18-25	Self-reported alcohol, tobacco and cannabis use	Deviance predicted substance group assignment in both adolescence and early adulthood. Adolescent depression predicted smoking group among females in early adulthood.
<b>Personality disorders</b>					
Moran et al. 2006 Australia	Longitudinal community sample	1145	24 (mean)	Daily smoking, ND, hazardous drinking, AUD, illicit drug use, CD	Most substance use measures associated with cluster B (dramatic or erratic behaviour) personality disorders. No such association was detected for cluster A (odd or eccentric behaviour) and cluster C (anxious or inhibited behaviour) personality disorders. No separate analyses were performed for males and females.
Kantöjärvi et al. 2006 Finland	Longitudinal birth cohort, this study was a cross-sectional analysis	1609 (642)	31	SUD	Cluster C (anxious or inhibited behaviour) personality disorders associated with SUD. No separate analyses were performed for males and females.

<sup>1</sup>Population-based studies with 1000 participants or more were selected. <sup>2</sup>Number of males in the analyses if information was available in the original publications.

**Abbreviations:** AD=Alcohol dependence, APD=Antisocial personality disorder, AUD=Alcohol use disorder, CaD=Cannabis dependence, CUD=Cannabis use disorder, COMT=Catechol-O-methyltransferase, DUD=Drug use disorder, MDD=Major depressive disorder, ND=Nicotine dependence, SUD=Substance use disorder, Val=Value

**Table 7. (continued) Summary of findings from selected<sup>1</sup> birth cohort studies on psychiatric disorders and substance use in late adolescence or early adulthood.**

Author, location	Study design	N (males) <sup>2</sup>	Age, years	Measure of substance use	Findings/comment
<b>Psychosis</b>					
Andréasson et al. 1987 Sweden	Longitudinal follow-up study of males conscripted for compulsory military training in 1969-1970	45 570	18 to 33	Self-reported cannabis use	Use of cannabis increased the risk of schizophrenia after controlling for other psychiatric illness and social background.
Weiser et al. 2004 Israel	Longitudinal follow-up study of males conscripted for compulsory military training in 1969-1970	14 248	17 to 21-33	Self-reported smoking	Smoking more than 10 cigarettes a day associated with later schizophrenia diagnosis.
Stefanis et al. 2004 Greece	Cross-sectional community study, high school students	3500 (1575)	19	Self-reported illicit drug use	Use of cannabis, but not depression associated with psychosis. First use of cannabis under age 16 years was associated with a much stronger effect than first use after age 15 years, independent of lifetime frequency of use. No separate analyses were performed for males and females.
Fergusson et al. 2005c New Zealand	Longitudinal birth cohort study	1055	25	Frequency of cannabis use at ages 18, 21 and 25 years	Regular cannabis use increased risks of psychosis were performed for males and females. No separate analyses were performed for males and females.
Ferdinand et al. 2005 Netherlands	Longitudinal birth cohort study	1580 (732)	4-16 to 18-30	Self-reported tobacco, alcohol, and cannabis use	Cannabis use predicted psychotic symptoms and vice versa. A bi-directional causal relationship between cannabis use and psychotic symptoms was suggested. No separate analyses were performed for males and females.
Henquet et al. 2005 Germany	Longitudinal community study	2437	14-24 to 18-28	Self-reported cannabis use	Cannabis use independently of confounding factors increased the risk of psychotic symptoms. No separate analyses were performed for males and females.
Wittchen et al. 2007 Germany	Longitudinal community study	1019	14-17 to 24-27	Self-reported cannabis use, SUDs	In cross-sectional and prospective analyses, other SUDs, mood and anxiety disorders were associated with cannabis use and CUD. Associations of panic-anxiety with CU and of depressive and bipolar disorders with CU and CUD were significant after controlling for externalizing disorders. No separate analyses were performed for males and females.

<sup>1</sup>Population-based studies with 1000 participants or more were selected. <sup>2</sup>Number of males in the analyses if information was available in the original publications.**Abbreviations:** AD= alcohol dependence, APD=antisocial personality disorder, AUD=alcohol use disorder, CaD=cannabis dependence, CUD=cannabis use disorder, COMT=catechol-O-methyltransferase, DUD=drug use disorder, MDD=major depressive disorder, ND=nicotine dependence, SUD=substance use disorder,



### 2.5.2 Education and occupation

Educational and occupational problems are common among substance-using young people (Lewinsohn et al. 1995, Fergusson et al. 2003c, Compton et al. 2007, Hasin et al. 2007). A relationship between deviant behaviour, substance use and school dropout has been widely reported in the literature (e.g. Mensch and Kandel 1988, Battin-Pearson et al. 2000). Fergusson et al. (2001) found that increasing exposure to unemployment was associated with increasing risk of SUD. In the Dunedin study, frequency of drinking was more prevalent among those with higher income, and this was found to persist over teenage and young adult years (Casswell et al. 2003). However, the less well-educated young adults and the unemployed have been found to drink significantly more during a drinking occasion and at all ages (van Oers et al. 1999).

### 2.5.3 Social relations

Substance use associates with social relations, and it can be a way to fit in with, or bond with, a social group. As adolescents grow older, the family becomes less important for the socialization process, while the influence of a person's group of friends increases (Kokkevi et al. 2007). Peers can influence individuals directly (e.g. by offering drinks, round buying or forcing others to drink in drinking games), and indirectly through modelling and perceived norms. Social modelling (friends' substance use behaviour, friends' attitudes, and perceived peer pressure) has also been indicated as a correlate of individual substance use behaviour (Brook et al. 1990, Bricker et al. 2006, Kokkevi et al. 2007, Kuntsche et al. 2004, von Sydow et al. 2002). Furthermore, deviant peer affiliations, particularly at younger ages, have been found to associate with increased rates of SUDs and criminality (Fergusson et al. 2002).

Catalano et al. (1996) have proposed in their *social development model* that children learn patterns of behaviour from socializing units of family, school, peers and community institutions. In their model, a prosocial pathway and an antisocial pathway are described. According to the social developmental theory, processes of socialization in each pathway involve four constructs: (1) perceived opportunities for involvement in activities and interactions with others; (2) the degree of involvement and interaction; (3) the skills to participate in these interactions; and (4) the rewards or costs of involvement.

### 2.5.4 Criminality

The evidence of the association between substance use and criminality is strong (Loeber and Farrington 2000, Farrington 2003). Analogous to substance use, the prevalence of criminal behaviour peaks in late adolescence, then declines with age (Loeber and Farrington 2000, Farrington 2003). Furthermore, the occurrence of psychiatric disorders generally coincides with offending at the same stage of life (Arseneault et al. 2000). SUDs, especially alcohol abuse, have been shown to independently predispose to crime (Fergusson and Horwood 2000). Impaired executive cognitive functioning during intoxication has been found to increase the risk of violent behaviour (Pihl et al. 2003), offending, and risk-taking (Leigh 1999). Antisocial behaviour and substance abuse often co-occur (Regier et al. 1990), and both of these behaviours have also been found to associate with poor impulse control (Bechara 2005), novelty seeking (Khan et al. 2005), and aggressive behaviour (Haller and Kruk 2006).

In previous studies, offending at a young age has been classified according to *number of offences* and *development and timing in the life-course* (Moffitt 1993, Loeber and Farrington 2000). Moffitt (1993) has proposed taxonomies of life-course-persistent versus adolescent-onset of antisocial behaviour. Life-course-persistent antisocial behaviour has been shown to associate with both individual and family adversities early in life, while for adolescent-limited antisocial behaviour, these associations are not as obvious (Moffitt et al. 2002, Silberg et al. 2007, Odgers et al. 2007).

Little research has been conducted to study legal categories of crime and various crime types (Loeber et al. 2003). In previous research, types of criminality have often been categorized as “violent” or “non-violent” type to indicate the crime type and seriousness (Tiihonen et al. 1997, Loeber and Farrington 2000, Loeber et al. 2003, Odgers et al. 2007).

The term **drug-related crime** can be used to encompass four types of crimes: (1) Psychopharmacological crimes: crimes committed under the influence of a psychoactive substance, as a result of its acute or chronic use; (2) Economic-compulsive crimes: crimes committed in order to obtain money (or drugs) to support drug use; (3) Systemic crimes: crimes committed within the functioning of illicit drug markets, as part of the business of drug supply, distribution and use; and (4) Drug law offences: crimes committed in violation of drug (and other related) legislations. (EMCDDA 2006)

**Drunk driving** at a young age has been estimated to associate strongly not only with SUDs (Lapham et al. 2004), but also with mental health problems, and violent offending (Räsänen et al. 1999b). In a Finnish study, regular and heavy alcohol use and smoking at age 14 years predicted later drunk driving offences, and these associations were more evident for males than females (Riala et al. 2004). In the same study cohort, growing up in a single-parent family was found to predict early-onset, late-onset, and recidivistic drunk driving (Sauvola et al. 2001).

**Drug offending**, in turn, has been little studied. Fergusson et al. (2003d) have indicated that individual characteristics differentiate cannabis offenders from those with self-reported cannabis use without cannabis-related crime. In that study, cannabis offending was found to associate with recidivist crime. In a study of felony drug offenders, approximately 40% to 60% were reported to have comorbid psychiatric disorders (Belenko et al. 2003). In a Finnish study, convicted drug offenders were found to start their criminal career at an early age (age 15), most commonly with property crime (Kinnunen 2001). In that study, the mean age for a drug conviction was 22 years. The most typical drug offence was found to be possession of cannabis or amphetamine, and 43% of the drug offenders were aged 19 to 25 years (Kinnunen 2001). A survey carried out in 2004 among 15- to 16-year-olds in Finland showed that about 7 % of those who had used cannabis in the last year had financed their use illegally, more than half by selling drugs, and the rest mainly by stealing (Kivivuori 2005). According to a Finnish follow-up study, two out of three of the adolescents who had been interrogated by the narcotics police in the early 1970's had a poor outcome 20 years later (Turpeinen 1999). In that study, property crime and intravenous drug use associated with later imprisonment, psychiatric hospitalization, and death (Turpeinen 1999).

### 2.5.5 Help-seeking

It has been estimated that alcohol abuse and dependence have the widest treatment gap of all mental health problems (Kohn et al. 2004). In a study from the United States only one out of five of all adults with alcohol dependence were estimated to receive treatment for their alcohol problems during their lifetime (Hasin et al. 2007). Similarly, most individuals with drug use

disorders (DUDs) have never been treated, despite of the substantial disability and comorbidity associated with DUDs (Compton et al. 2007). In particular, individuals with multiple dependencies have been estimated to have the highest need for mental health services (Kandel et al. 2001). Referral to appropriate services has been found to be inadequate, especially among young people with SUDs (McLellan and Meyers 2004). To date, only a few studies on adolescent substance use and mental health service use have been carried out in a nationwide sample (Wu et al. 2002, Wu et al. 2003). In the United States, Aarons et al. (2001) reported that about one-fourth of the 16-18-year-old boys involved in publicly funded youth-serving agencies had a past-year diagnosis of alcohol use disorder. Furthermore, psychiatric comorbidity among substance-using youths may also have an impact on their treatment response and prognosis. For instance, adolescents with disruptive disorders have been found to have a poorer response to treatment and a poorer prognosis (Kaminer and Burleson 1999). On the other hand, youths with affective or adjustment disorder have been found to have a better prognosis for completing treatment than those with a disruptive disorder, such as conduct disorder (Kaminer and Burleson 1999).

### **3 AIMS OF THE STUDY**

The aim of this thesis was to investigate childhood risk factors and correlates of substance-use-related behaviour among Finnish young men in a nationwide longitudinal birth cohort study.

The specific aims were:

1. To investigate childhood predictors at age eight for drunkenness, cigarette smoking, and illicit drug use at age 18 (studies I-IV) and substance-use-related offending at age 16 to 20 years (studies III, IV).
2. To compare the predictive value of different childhood informants (parent, teacher, child himself) with regard to later substance-use-related outcomes (studies I, II, IV).
3. To investigate the associations between adaptive functioning, psychopathology and crime, and substance-use-related outcomes in early adulthood (studies III, V and VI).
4. To investigate the associations between help-seeking and drunkenness at age 18 (study V).

## 4 SUBJECTS AND METHODS

### 4.1 Study design

The design of this study was that of a prospective follow-up in a nationwide birth cohort, part of the “From a Boy to a Man” study. The study cohort is based on the Finnish Epidemiological Multi-center Child Psychiatric Study, which was conducted in 1989 (Almqvist et al. 1999a).

### 4.2 Study population

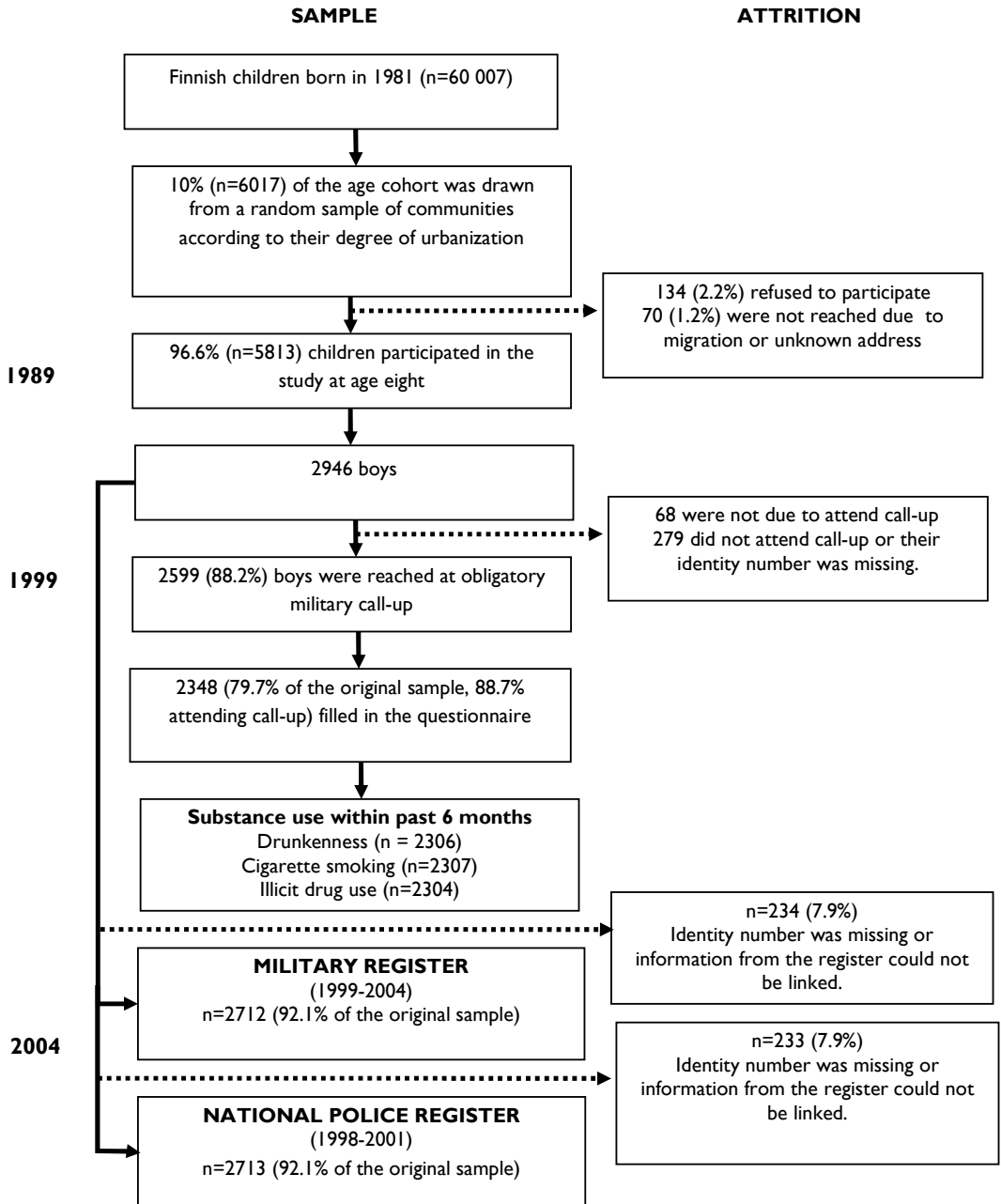
#### 4.2.1 Sample selection in 1989

**A flow chart of the participation in the study is presented in Figure 9.** The original study sample was selected from the total population of Finnish children born during 1981 ( $n = 60\,007$ ). A sample of about 10% of the Finnish-speaking population was drawn in the catchment areas of the five child psychiatric departments of the university hospitals in Finland (Helsinki, Kuopio, Oulu, Tampere and Turku). A representative sample of all the communities, according to their degree of urbanization: urban, suburban, rural, was selected from each university hospital district. All children from the small communities belonging to the 1981 age cohort attending school participated in the study. In the large cities, a representative subsample was drawn from all the school districts.

Altogether, the selected sample consisted of 6017 children. Most children ( $n=5813$ ; 96.6%) of the selected population participated in the study in 1989. The attrition due to migration or unknown address was 1.2 %, and the attrition due the refusal to take part in the study was 2.2%. Of the 5813 children participating in the study, 2946 (50.6%) were boys. The Helsinki region was slightly underrepresented, and the regions of Turku and Oulu were overrepresented. The small differences among the five regions in sex ratio were not significant.

The majority (97.6%) of the 8-year-old children attended primary school. Of these, 0.6% were in special classes for the behaviourally disturbed, 0.1% in special classes for the physically handicapped, 0.8% in special classes for the learning disabled, 0.5% in classes for the mentally retarded, and 0.4% in other types of educational training. Severely disabled children, e.g. with severe mental retardation not attending school were excluded. Furthermore, 96.6% of the children were attending second grade, 3.1% first grade and 0.2% third grade; proportions almost identical to the official educational statistics (Almqvist et al. 1999a). **Family characteristics of the participants at age eight are presented in Table 8.**

Figure 9. Study sample and attrition



**Table 8. Family background characteristics at age eight (1989).**

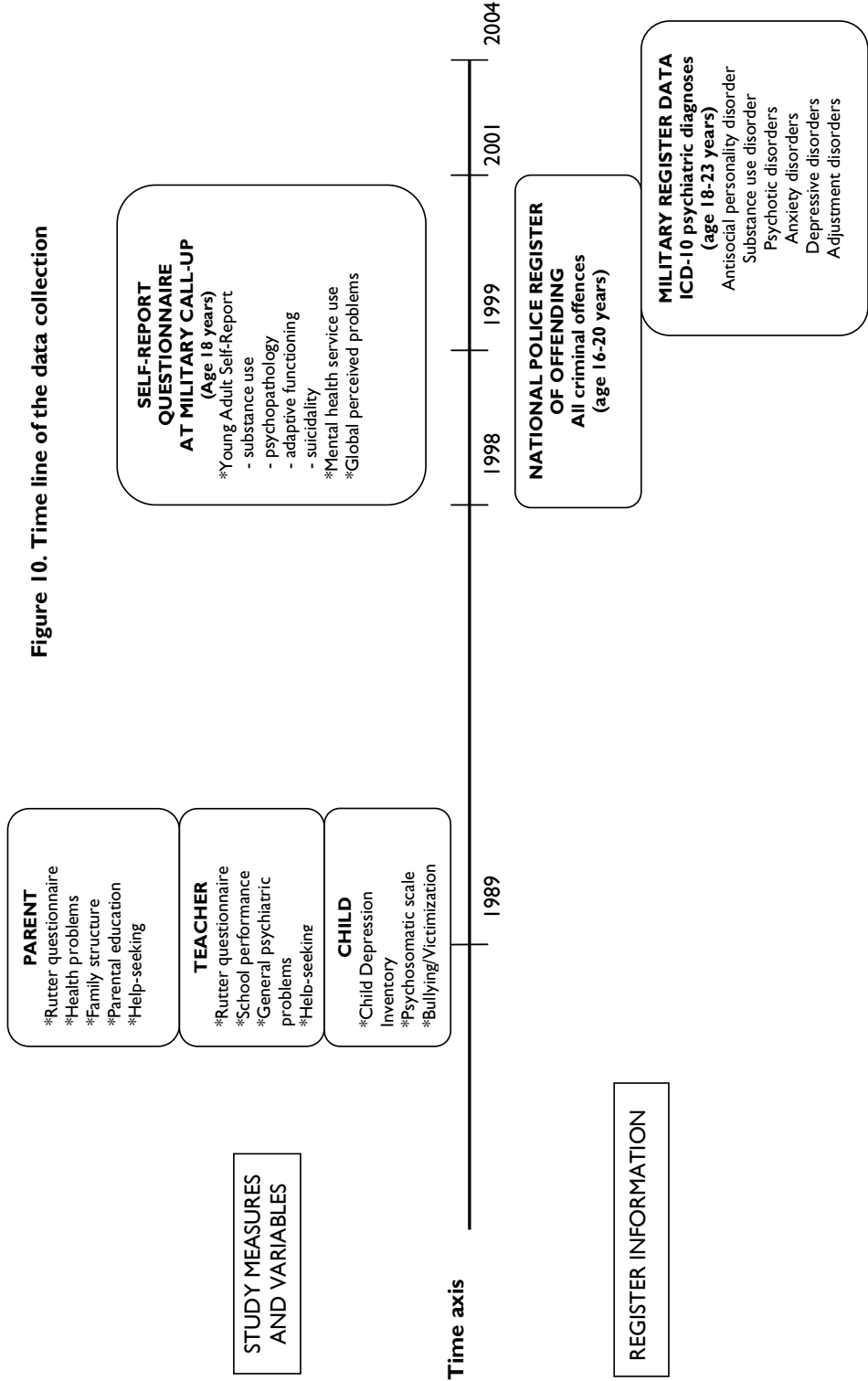
	Total n <sup>1</sup>	%
<b>Family structure</b>	2848	
Two biological parents	2358	82.8
One biological parent and one step-parent	410	14.3
One biological parent	46	1.6
Other	34	1.1
<b>Mother's education level</b>	2767	
Not completed upper secondary school	1943	70.2
Completed upper secondary school	824	29.8
<b>Father's education level</b>	2537	
Not completed upper secondary school	2000	78.8
Completed upper secondary school	537	21.2

<sup>1</sup>number of observations

### 4.3 Data collection in 1989

**A time line of the data collection is presented in Figure 10.** The first assessment was conducted between October and November 1989. Data were collected using multiple informants: parents, teachers, and children themselves. Data collection was organized through teachers. The teacher sent the parent questionnaires via the child to the parents and the parents returned it in a sealed envelope to the teacher. If the questionnaire was not returned, a new one was sent to the parents twice, with a two-week interval. Most of the parental informants were mothers, only about one in ten was the father of the child. The effect of the parents' gender on the agreement was studied among all children, and it did not appear to have any impact (Kumpulainen et al. 1999).

The children filled in a self-report questionnaire in the classroom. The teacher who knew the child best filled in the teacher's questionnaire. The teacher sent the parent questionnaires, the parents' written consent sheet, the teacher questionnaires, and the child self-reports in sealed envelopes to the researchers. Each class also had a follow-up sheet, in which the teacher marked how many pupils, born in which years, and how many parents had returned the consent paper and questionnaires, and how many had and had not given permission for participation in the study. At the end of the study, the follow-up sheets, study questionnaires and consent forms were returned to the researchers. The researchers visited each school and met the teachers involved.





## 4.4 Measures at age eight

### 4.4.1 Teacher's Questionnaire

Teachers were asked to evaluate the child's behaviour within the past 12 months. Teachers filled in the **Rutter Teacher Questionnaire**, developed to evaluate behaviour occurring at school within the past 12 months. The scale includes 26 items, of which 23 are identical to the items in Rutter's questionnaire for parents. The remaining three items deal with problems, habits or behaviour specific to school. The items are rated on a scale of 0-2, and the range of scores is 0-52 points scale. The teacher is asked to respond to each item by selecting a statement suitable for the child with alternatives 0= does not apply, 1=applies somewhat and 2 =certainly applies. The items are summed up on each scale into a total score that measures overall deviance. Total scores of nine or more on the teacher questionnaire indicate probable psychiatric disorder. The teacher scale includes three subscales; antisocial (6 items on the teacher questionnaire), hyperkinetic (3 items) and neuroticism (4 items). The conduct scale inquires about behaviours such as disobedience, defiance, fits of temper, aggression, destruction of property, stealing and lying. The hyperactivity scale asks questions related to inattention, short attention span, distractibility, restlessness and hyperactivity). The neuroticism scale asks about shyness, anxiety, and withdrawal behaviours. These three subscales are later in the text referred to as conduct problems, hyperactive or attention problems, and emotional problems. (Rutter 1967)

Concerning **reliability**, the Rutter Teacher Questionnaire has been reported to have an adequate internal consistency, with a coefficient of 0.7 with different teachers (Rutter and Graham.1968). The test-retest reliability has been found to be good (0.9) when the same teacher carried out the rating on each occasion over a 2-3 month interval (Rutter and Graham 1968). Concerning **validity**, the sensitivity was found to be 0.8 and the specificity 0.4, when the Rutter Teacher Questionnaire was compared with a parent interview (Rutter et al. 1976). When the Finnish version of the Rutter Teacher Questionnaire was compared with the combined (parent, teacher and child) Diagnostic Interview Schedule for Children (DISC) rating, the Area Under the Curve (AUC) in the Receiver Operating Characteristic analysis (ROC) was 0.8 indicating accurate validity of this questionnaire (Kresanov et al. 1998).

A question about **child's school performance** was included in the teacher questionnaire. A Likert scale (1=better than average, 2= average, 3= poor) was used to record teachers' responses.

**Psychological problems** were asked about with the question, "Is the child psychologically healthy?"; with alternatives 1=yes, 2=I don't know, 3=no. Information about **help-seeking and perceived need of help** was obtained from teachers with the question: "Have you considered seeking or have sought help or treatment because of emotional or behavioural problems of the child?" The alternatives were 1=no, 2=have considered it, 3=have sought help.

### 4.4.2 Parent's Questionnaire

Parents were asked to evaluate the child's behaviour within the past 12 months. The parents filled in the **Rutter Parent Questionnaire**, which consists of 31 items (Rutter 1970). The answers are rated on a scale of 0-2, with alternatives 0= doesn't apply, 1=applies somewhat, and 2=certainly applies. The total score for the questionnaire ranges from 0 to 62 points. Also here, the items are summed up on each scale into a total score that measures overall deviance. Total

scores of 13 or more on the parent questionnaire indicate probable psychiatric disorder (Zahner et al. 1992). The parent scale includes three subscales; antisocial (5 items on the parent questionnaire), hyperkinetic (3 items) and neuroticism (5 items). These three subscales are later in the text referred to as conduct problems, hyperactive/attention problems, and emotional problems.

Concerning **reliability** of the Rutter Parent Questionnaire, Rutter and Graham (1968) have reported the test-retest reliability of mothers' ratings after a 3-month interval to be 0.7. **Validity** of the Finnish version of the Rutter Parent Questionnaire has been estimated, comparing the Rutter Parent Questionnaire with the combined interview rating (parent, teacher and child). In that study, the AUC in the ROC analysis was 0.7 (Kresanov et al. 1998).

The child's **somatic health problems** were asked about with the question, "Is the child physically healthy?" with alternatives 1=yes or 2=no. Information about **help-seeking and perceived need of help** was obtained from parents with the question: "Have you considered seeking or have sought help or treatment for your child's emotional or behavioural problems?" The alternatives were 1=no, 2=have considered it, 3=have sought help.

**Family background variables** were covered by the parent questionnaire. Information about **family structure** was collected with the question: "The primary caretakers of the child are..." with alternatives 1=two biological parents, 2=biological mother and a step-father, 3=biological mother alone, 4= biological father and a step-mother, 5=biological father alone, 6=adoptive parents, 7=foster parents, 8=other (please specify). In the current thesis, intact family structure was determined as living with two biological parents. Any other kind of family arrangement was referred to as a non-intact family structure. **Parental education level** was studied by father's and mother's completion of schooling with alternatives 1= elementary school (six to eight years of schooling in Finland), 2= comprehensive school (nine years of schooling), 3=upper secondary school (12 years of schooling), and 4=not completing elementary of comprehensive school. In the current thesis, not completing upper secondary school was referred to as a low educational level.

#### 4.4.3 Child's questionnaire

**The Child Depression Inventory (CDI)** is the most widely used self-rating scale of depressed mood in children. It is derived from the Beck Depression Inventory to assess cognitive, affective and behavioural signs of depression in children and adolescents aged 7 to 17 years (Kovacs 1992). The CDI includes 27 items, each of which has three statements on a 0-2 scale. For each item the child has three possible answers; 0 indicating an absence of symptoms, 1 indicating mild symptoms, and 2, definite symptoms. The items include cognitive, affective, and behavioural aspects of childhood depression during the previous two weeks. Overall scores ranges from 0 to 54 (Kovacs 1992). In the present thesis, the question about suicidal ideation was omitted because it was thought that it might have confused children. Thus, the Finnish version of the CDI consisted of 26 questions, with a range of 0 to 52 points.

The psychometric properties of the CDI have been studied comprehensively. It has been shown to have an adequate internal consistency, with coefficients ranging from 0.6–0.9. The test–retest **reliability** of CDI has been found to be highly variable and has been considered moderate, with coefficients ranging from 0.4 to 0.9. The test-retest reliability of the CDI has been suggested to be influenced by study design variables, such as the length of the test-retest interval and the study sample. The test-retest reliability of the CDI has been found to be somewhat lower for

boys than for girls. Similar to other such measures, a poor child–adult concordance has been reported, which improves as children mature (Myers and Winters 2002).

The **validity** of the CDI has been supported by correlations with multiple other scales, including those measuring related constructs such as self-esteem, cognitive distortions, locus-of-control, attributional style, and underachievement (Myers and Winters 2002). It has also shown predictive validity for future functioning (Myers and Winters 2002). However, findings on discriminative validity have been contradictory: some studies have found that higher CDI scores differentiate depressed from other psychiatric youths, but others have not, and sensitivity and specificity are poor (Myers and Winters 2002). The lower cut-off point of 13 is recommended for screening in clinical populations (Kovacs 1992). Kovacs (1992) has recommended CDI cut-off points from 16 to 19 to minimize the proportion of false positives in epidemiological studies. Timbremont et al. (2004) have reported that cutoff scores of 13 and 19 have satisfactory ROCs, and a cutoff score of 16 has an optimal relation between sensitivity and specificity, when depression was assessed using the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders Child Edition (KID-SCID). Kresanov et al. (1998) have reported from the current sample that the cut-off point of 17 had a true positive rate of 34.2%, and a false positive rate of 21.6% when compared with the combined diagnostic interview using DISC.

In the children's questionnaire, a **psychosomatic symptom scale** was developed for the purposes of the present study, including questions about headache, stomach ache, nausea, and other pains. This scale included four items rated on a 0-2 scale, with a range of scores of 0-8 points. For each item the child has three possible answers; 0 indicating an absence of symptoms, 1 indicating mild symptoms, and 2, definite symptoms, e.g. 1= I have stomach ache nearly every day, 2= I have stomach ache often, and 3= I have stomach ache only seldom.

The children were also asked about **bullying** other children at age eight. The alternatives were: 1="I do not usually bully other children", 2="I sometimes bully other children", 3="I bully other children nearly every day". Furthermore, children were asked about **being victims of bullying**: 1="other children do not usually bully me", 2="other children sometimes bully me", 3="other children bully me nearly every day".

When collecting the 1989 survey data, missing information on an item was replaced by the mean value of (1) the mean of that item among the peer subjects in the same class, and (2) the mean of that item among the subjects in the same region, provided that the proportion of questions with missing information was less than one third of the total number of items on the scale. When there was no answer for one third or more of the questions, the questionnaire in question was excluded. Less than 1% of the returned forms had to be excluded. The response rate for all three questionnaires was 94.1% (n = 5664); for the parent questionnaire 95.5% (n = 5746); for the teacher questionnaire; and 94.5% (n = 5685) for the CDI (Almqvist et al. 1999b).

#### 4.4.4 Psychopathology types

To address different psychopathology types, 16 different combinations of symptoms were formed by the 90<sup>th</sup> percentiles of the four scales (conduct, attention, emotional, and CDI). These 16 groups were collapsed into six groups to define clinically meaningful types. This reduction was done a priori: (1) Children who were negative (below the 90<sup>th</sup> percentile) on all four scales. This group was used as the **reference group** in the statistical analyses; (2) Children who were conduct + and (emotional + OR CDI +), indicating that they had a high level of symptoms in conduct and emotional domains, the **Conduct-emotional (C-E) group**; (3)

Children who were positive on the Conduct scale and negative on parent/teacher/child emotional scales (emotional - and CDI-), the **Conduct-only group**; (4) Children with attention problems, but without presence of conduct problems, the **Attention group**; (5) Children with parent- or teacher-reported emotional problems who were negative on conduct and attention scales, the **Emotional-only group**; (6) Children who reported high depressive symptoms but were screen negative on all three scales based on parent/teacher reports, referred to in the text as the **Invisible group**.

## 4.5 Follow-up in 1999

Military service lasting from six to 12 months is obligatory for Finnish boys. The boys participating in the study in 1989 had their military call-up in 1999. Finnish male citizens have a medical examination during the spring of the year they turn 18. The purpose of the examination is to get a preliminary assessment of their general health and fitness class for military service. After the examination, they must attend call-up between September and November of the same year. At call-up, there is a brief medical examination, the purpose of which is to check whether there are any health changes, which could change the preliminary fitness class. After the medical examination, a call-up board, which consists of two soldiers and one civilian, confirms the fitness class. Of those who are regarded as fit for service, approximately 80% start their military service within 2 years after the call-up, and the rest by the year they turn 30 (Multimäki et al. 2005).

Of the original 2946 boys, 2878 were due to receive their call-up between September and November 1999. Altogether, 279 of them did not attend the call-up during the given time period (most of them had already volunteered for military service, four had a legal excuse, and 13 were illegally absent). Thus, a total of 2599 (88.2%) of the original sample were reached. Of these boys, 2348 (79.7% of the original study population, 90.3% attending call-up) filled in the given questionnaires. The dropout group from the original study population - those who took part in the study in 1989 but did not fill in the questionnaire in 1999 - was more closely studied. The dropouts had a significantly higher level of psychopathological features at age eight, and their family structure was more often other than two biological parents (Haavisto et al. 2005).

## 4.6 Data collection in 1999

On a voluntary basis, participants filled in the questionnaire at call-up. To avoid reporting bias, the respondents returned the questionnaire in a sealed envelope. The researchers informed the participants that the military personnel or any other authority has no access to the collected data. Furthermore, they were informed that the collected data are analyzed anonymously.

## 4.7 Measures at age 18

### 4.7.1 Self-reported substance use

Self-reported **frequency of drunkenness** was studied by the question: “*How many times have you been drunk during the past six months?*” This question is part of the Young Adult Self-Report questionnaire (YASR) (Achenbach 1997). The four-point scale in the YASR questionnaire was: 1=never, 2=once a month or less, 3=less than once a week, and 4=once a week or more often.

Self-reported **cigarette smoking frequency** was determined with the question: “*How often have you been smoking during the past six months?*” This question is part of the Young Adult Self-

Report questionnaire (YASR) (Achenbach, 1997). The five-point scale in the YASR questionnaire was: 1= never, 2= occasionally, 3= one to five cigarettes a day, 4=six to ten cigarettes a day, and 5= more than ten cigarettes a day.

Self-reported **illicit drug use** during the six months prior to military call-up was studied with the question: “How often have you used drugs during the past six months (such as cannabis, amphetamine, intoxicating drugs)?” with the alternatives 1=never, 2= once a month or less, 3= less than once a week, 4= once a week or more often. This question is part of the Young Adult Self-Report questionnaire (Achenbach 1997).

#### 4.7.2 Sociodemographic information

The questionnaire included questions concerning family structure (biological parents/other family structure), living place (urban/rural, size of the community), moving away from home, parental divorce, parental severe illness, parental death, occupation, and education level. **Sociodemographic characteristics of the participants at age 18 are presented in Table 9.**

**Table 9. Sociodemographic characteristics at age 18 (1999)**

	n	%
<b>Community size</b>	2317	
< 1000 inhabitants	902	38.9
1000-100 000 inhabitants	1001	43.2
>100 000 inhabitants	414	17.9
<b>Occupation</b>	2020	
Student	1729	85.5
Working	224	11.1
Unemployed	40	2.0
Student + working	21	1.0
Other	6	0.3
<b>Education level</b>	2297	
Basic education (9 years of schooling)	1365	59.4
Upper secondary school (12 years)	356	15.5
Vocational school (12 years)	576	25.1
<b>Living arrangements</b>	2348	
Living with parents	2114	90.0
Living alone	114	4.9
Living with a spouse	38	1.6
Other	82	3.5
<b>Regular relationship</b>	2328	
No	1422	61.1
Yes	906	38.9
<b>Parent’s divorce</b>	1966	
No	1370	69.7
Yes	596	30.3
<b>Serious illness of a parent</b>	1636	
No	1507	92.1
Yes	129	7.9
<b>Death of a parent</b>	1661	
Both parents are living	1539	92.7
Mother or father has died	122	7.3

<sup>1</sup>number of observations

### 4.7.3 The Young Adult Self-Report

The Young Adult Self-Report (YASR) is a questionnaire for 18–30-year-olds. It contains 110 problem items which are scored 0=not true, 1=somewhat or sometimes true, or 2=very true or often true. Psychiatric symptoms can be scored on a total problem scale, two subscales, and eight syndromes; withdrawn, anxious/depressed (together constituting the internalizing scale); delinquent behaviour, aggressive behaviour, intrusive behaviour (together constituting the externalizing scale); somatic complaints, attention problems, and thought problems. The 90<sup>th</sup> percentile cut-off point based on the distribution of scores in the present sample was considered to depict poor adaptive functioning or psychopathological problems on each of these scales. The questions concerning substance use in the YASR delinquency item were removed before statistical analysis.

YASR also includes 20 competence and socially desirable items investigating adaptive functioning in five life areas: family, friends, spouse/partner, education, and occupation. On the competence scale, items concerning spouse/partner, education, and occupation are scored 0=not true, 1=somewhat or sometimes true, or 2=very true or often true. The friend scale estimates quality of friendships with the following questions: “How many close friends do you have?”, “How many times a month are you in contact with some of your close friends?”, “How well do you get along with your friends?”, and “How many times a month do you invite your friends to your home?” (Achenbach et al. 1995, Achenbach 1997)

Good reliability and validity for this measure have been reported. Concerning **reliability** reports, a high test-retest reliability ( $r=0.9$ ) over 18 days for the total problem score in a general population sample in Netherlands has been reported (Ferdinand et al. 1995). The one-week test-retest correlation has shown an average of 0.9 across the YASR syndromes, internalizing, externalizing, and total problems (Achenbach et al. 1995). Concerning **validity**, higher scores for subjects referred to mental health services compared to demographically matched non-referred subjects on internalizing, externalizing, total problems, and all syndromes except intrusive and somatic complaints have also been reported (Achenbach et al. 1995). When compared with DSM-III-R diagnoses, receiving two or more DSM diagnoses obtained higher YASR Total problem scores (mean=70.2) than those receiving only one diagnosis (mean=46.3) or no diagnosis (mean=31.6) (Achenbach et al. 1995). In addition, significant correlations between YASR syndromes and many specific DSM diagnoses have been found (Achenbach et al. 1995).

YASR has also been shown to be valid compared to other widely used assessment instrument, such as the Symptom Checklist (SCL-90), and the General Health Questionnaire (GHQ-28) (Ferdinand and Verhulst 1994). In that 2-year follow-up study of a general population sample of 18- to 22-year-olds, referral to mental health services and need for professional help were predicted by the total problem scores of the YASR, the GHQ-28 and the SCL-90 and by the internalizing scale of the YASR. Furthermore, the YASR internalizing scale predicted suicide attempts or suicidal ideation, while the YASR externalizing scale predicted police contacts. The YASR delinquent behaviour syndrome was found to be the only significant predictor of alcohol abuse (Ferdinand and Verhulst 1994).

The reliability and validity of the Finnish version of the YASR have not been studied. However, the Youth Self-Report (YSR) version designed for adolescents 11 to 18 years has been studied among 16-year-old Finnish adolescents (Helstelä and Sourander 2001). When testing internal

consistency, the alpha coefficient for YRS syndrome scales ranged from 0.6 to 0.9. The internal consistencies were lowest for the social problem (0.6) and thought problem (0.7) scales (Helstelä and Sourander 2001).

#### **4.7.4 Suicidality**

Suicidal ideation was studied with the YASR question “I think about killing myself”, and suicidal acts with the question: “I deliberately try to hurt or kill myself”, with responses 0=not true, 1=somewhat or sometimes true, or 2=very true or often true. These items were categorized into “yes” or “no”. According to the answers to these questions, suicidality was divided into three categories: those not having suicidal thought or acts (referred to as “not suicidal”), those having suicidal thoughts only (referred to as “suicidal ideation”), and those with suicidal acts or deliberate self-harm, including those with suicidal ideation as well (referred to as “suicidality/deliberate self-harm”).

#### **4.7.5 Health and self-perceived mental problems**

Additionally, the boys were asked about their health problems with a YASR question “Do you have any illness, disability or handicap?” with alternatives “yes” and “no”. Global perceived psychological problems were studied with the question “Do you have emotional, behavioural or relational problems?” with the alternatives 1=no, 2=mild problems, 3=moderate problems, 4=severe problems.

#### **4.7.6 Help-seeking**

The self-reported use of mental health services during the preceding 12 months was studied with the question: “Have you sought help or have you been referred for assessment because of behavioural, emotional or relational problems during the last 12 months?” The questionnaire mentioned separately possible sources of help (e.g. psychiatric outpatient and inpatient unit, child guidance clinic, school psychologist, substance use treatment, youth clinic, private doctor). Adolescents were included in the service use group, if they had been in contact with mental health services during the 12-month period.

### **4.8 Register-based information in early adulthood**

#### **4.8.1 Military Register**

By March 2004, 80.4% of the men born in Finland in 1981 had completed military service, i.e. 6, 9, or 12 months, while 9.5% had been permanently exempted from service, 6.8% had completed non-military service, and 3.3% had not completed their obligatory service. The cumulative information on psychiatric diagnoses in the present study was based on the Military Register information including all psychiatric diagnoses from the call-up health examination in autumn 1999, and the Military Register information at two time-points, in October 2002 and March 2004. During that period, the subjects were 18-23 years old. The diagnoses were made at the mental health examination at call-up, during the military service, or at the health examination evaluating the subjects’ fitness for the military. Information about possible psychiatric diagnoses is not necessarily the same at the different time-points. The more severe and chronic psychiatric diagnoses were usually based on consultation with specialized psychiatric services, while a less severe diagnosis may be based on an assessment by a general practitioner. The general

practitioner also obtains information from the school and health care system, which can be considered to increase the accuracy of the diagnoses. Thus, information is collected widely, and also those individuals are reached who have not been in contact with psychiatric services in the health care sector. Altogether, information on the presence or absence of subjects' psychiatric diagnoses according to the military register was available for 2712 boys (92.1% of the original study sample). The case histories of the men belonging to the Turku military province (Finland is divided into 12 military provinces) were checked (13% of those who had a psychiatric diagnosis) (Sourander et al. 2005). In about 40% of the cases in that sample, the psychiatric diagnoses were based on consultation with a specialist in psychiatry, whereas in the remaining cases, they were based on an assessment by a general practitioner.

The register information about psychiatric diagnoses was based on the most recent assessment. The subject was classified into the "any psychiatric disorder" group if he had at least one psychiatric diagnosis according either to the ICD-10 classification system at the military call-up examination in 1999 or information obtained from the Finnish National Military Register in October 2002 or March 2004. According to data pooled from the three different time-points (1999, 2002, and 2004), subjects were classified into six disorder groups: antisocial personality, substance use, psychotic (including e.g. schizophrenia and schizophreniform psychosis), anxiety, depressive, and adjustment disorders. If the subject had a psychotic disorder at any of the three time-points he was not classified into any other group. Furthermore, subjects were classified into anxiety and depressive groups only if they did not have antisocial personality or substance use disorder. Only subjects with adjustment disorder who could not be classified into any of the other five disorder groups were classified into the adjustment disorder group. Otherwise, the subject could belong to more than one disorder group. It should also be noted that not all subjects with psychiatric diagnoses could be categorized into specific groups.

#### **4.8.2 National Police Register**

Data on the cohort's criminality were gathered from the National Police Register, an electronic database kept by the Finnish Police Administration. This nationwide register is a rather new procedure, dating back to 1997. It includes all incidents where it has come to the police's notice that someone has committed an offence. However, mere admonitions are not usually registered and nor are municipal parking fines. Furthermore, petty traffic infractions such as minor speeding were excluded from the data as trivial.

The current study is limited to crime registered in 1998-2001 when the subjects were 16-20 years old. Data are removed from the register according to a schedule based on limitation of prosecution by lapse of time. Data were collected from the register at two time-points (at the beginning of the years 2000 and 2002) to ensure that the data of the years 1998-2001 were complete. Register information of the year 1997 was not included because of missing data. Altogether, data were available for 2866 boys, 97.3% of the original sample. Linking offending data to information available, there were altogether 2713, 92.1% of the original sample whose information could be linked to data collected in 1989.

Based on the police data, subjects were classified into four groups: (1) no registered offences; (2) one or two offences; (3) three to five offences; and (4) more than five offences during the four-year period. Two jurists (Professor Ari-Matti Nuutila and Master of Laws Henrik Elonheimo) and a child psychiatrist (Professor André Sourander) reviewed all offence types and the classification of the crime types was based on a consensus decision on each offence type. Accordingly, criminality was divided into five categories: drug, violent, property, traffic, and drunk driving offences. The subjects could belong to more than one offence group. *Drug offences* refer to various kinds of drug-related activity, all forbidden in Finland: manufacturing, importing,



exporting, delivering, selling, purchasing, or merely possessing illegal drugs. According to law, drug offences can be categorized according to the quality and quantity of the drug. However, on the basis of these classifications made by the police, the exact nature of the drug offences cannot be reliably distinguished. *Violence* was defined as overt physical aggressive behaviour toward another human being. The main subgroups of violence were various kinds of assault and battery, and robbery. *Property crime* included covert behaviour targeted not at humans but at property. This category included stealing, illicit use of other's motor vehicle, receiving stolen goods, and damaging other's property. In addition, economic crime (such as fraud, embezzlement, forgery) belonged to this category. *Traffic offences* consisted of reckless driving and driving without a license. In Finland, the legal limit for *drunk driving* is a blood alcohol limit below 50mg/dL. Any person whose age is 15 years or more and who is arrested for driving under the influence of alcohol or other substances is immediately registered in the National Police Register.

#### 4.9 Variable description

Use of study variables in articles are described in **Table 10**, and their use at different time-points is described in **Table 11**.

**Table 10. Description of the outcome variables.**

<b>Study N:o</b>	<b>Outcome variable (0=Reference group)</b>	
Study I	<b>Self-reported frequency of drunkenness</b> 0=never 1=less than once a week (occasional drunkenness) 2=once a week or more often (frequent drunkenness)	
Study II	<b>Self-reported frequency of cigarette smoking</b> 0=never 1=occasionally 2=1-10 cigarettes a day (moderate daily smoking) 3= more than 10 cigarettes a day (heavy daily smoking)	
Study III	<b>Involvement with illicit drugs</b> 0=no self-reported illicit drug use nor police-registered drug offence 1= self-reported illicit drug use without police-registered drug offence (self-reporters) 2= at least one police-registered drug offence (drug offenders)	
Study IV	<b>Self-reported weekly drunkenness</b> 0=less than weekly 1=once a week or more often <b>Self-reported daily smoking</b> 0=non-smokers and occasional smokers 1=any daily smoking <b>Self-reported illicit drug use</b> 0=no 1=yes	<b>Military Register: ICD-10 Substance use disorder diagnosis</b> 0=no 1=yes <b>National Police Register: Drunk driving</b> 0=no 1=yes <b>National Police Register: Drug offending</b> 0=no 1=yes
Study V	<b>Self-reported frequency of drunkenness</b> 0=never 1=once a month or less 2=less than once a week 3=once a week or more often (frequent drunkenness)	
Study VI	<b>Military Register: ICD-10 Substance use disorder diagnosis</b> 0=no 1=yes	<b>National Police Register: Drunk driving</b> 0=no 1=yes <b>National Police Register: Drug offending</b> 0=no 1=yes

**Table 11. Description of methods at different time-points.**

Age (years)	Questionnaire		Register-based information		Article
	8	18	16-20	18-23	
<b>Method</b>					
<b>Parent's report</b>					
Rutter total score	x				I, II
Conduct problems	x				I, II
Hyperactive problems	x				I, II
Emotional problems	x				I, II
In need of help or had sought help for psychiatric problems	x				I, IV
Child's somatic health	x				I
Family structure	x				I-IV, VI
Mother's education level	x				I, II, IV
Father's education level	x				I, II, IV
Mother's and/or father's education level	x				III, VI
<b>Teacher's report</b>					
Rutter total score	x				I, II
Conduct problems	x				I, II
Hyperactive problems	x				I, II
Emotional problems	x				I, II
Psychological problems	x				I
In need of help or had sought help for psychiatric problems	x				I
School performance	x				I-III
<b>Self-report</b>					
<b>Substance use</b>					
Drunkenness		x			I, IV, VI
Smoking		x			II, IV, VI
Illicit drug use		x			III, IV, VI
<b>Psychiatric symptoms</b>					
Child Depression Inventory	x				I-III
Psychosomatic symptoms	x				I
Bullied by others	x				I
Bullying others	x				I
Perceived mental problems		x			IV, V
Suicidality/deliberate self-harm		x			IV, V
Mental health service use		x			IV, V
Total YASR problems scores		x			IV, V
YASR Internalizing syndromes		x			IV, V
YASR Externalizing syndromes		x			IV, V
YASR withdrawn		x			V
YASR anxious /depressed		x			V
YASR thought problems		x			V
YASR somatic complaints		x			V
YASR intrusive behaviour		x			V
YASR aggressive behaviour		x			V
YASR delinquent behaviour		x			V
YASR attention problems		x			V

**Abbreviations:** YASR=young adult self-report

Table II. (continued) Description of methods at different time-points.

Method	Questionnaire		Register-based information		Article
	8	18	16-20	18-23	
<b>Age (years)</b>					
<b>Self-report (continued)</b>					
<b>Adaptive functioning</b>					
Educational problems		x			IV, V
Occupational problems		x			IV, V
Poor friendship quality		x			V
Regular relationship		x			V
<b>Life events</b>					
Parent's divorce		x			V
Living with parent(s)		x			V
Serious illness of parent		x			V
<b>Combined reports</b>					
<b>Parent and teacher</b>					
In need of help or had sought help for psychiatric problems	x				IV
Conduct problems	x				III
Hyperactive problems	x				III
Emotional problems	x				III
<b>Rutter scales and CDI (all informants)</b>					
Conduct-Emotional	x				IV
Conduct-only	x				IV
Attention	x				IV
Emotional-only	x				IV
Invisible	x				IV
<b>Register information</b>					
<b>Military register</b>					
Any psychiatric diagnosis				x	III, IV, VI
SUD				x	III, IV, VI
APD				x	III, IV, VI
Depressive disorder				x	III, IV, VI
Anxiety disorder				x	III, IV, VI
Psychotic disorder				x	III, IV, VI
Adjustment disorder				x	VI
<b>Police register</b>					
Any crime			x		IV, VI
Number of crimes			x		IV, VI
Drug offence			x		III, IV, VI
Violent offence			x		IV, VI
Property offence			x		IV, VI
Traffic offence			x		IV, VI
Drunk driving offence			x		IV, VI

**Abbreviations:** APD= antisocial personality disorder, CDI=child depression inventory, SUD=substance use disorder

## 4.10 Statistical methods

Multinomial logistic regression was used to examine the relation between each of the hypothesized variables and the outcome in **studies I-V**. The multinomial technique gives one overall p-value for the association between each explanatory variable and the response variable. When a response variable has more than two categories this is a more comprehensive method compared to performing a separate binary logistic test for several categories of response variable. With this method, more precise estimates can be obtained for the standard errors for estimates of parameters (Hosmer and Lemeshow 2000). In **study VI**, cumulative logistic regression was used to analyze the associations between the explanatory and response variables. The strengths of the associations were expressed as odds ratios (OR) and their 95% confidence intervals (95% CI). An OR is statistically significant at the 5% level when the 95% CI does not include one. All tests were two-tailed, with significance defined as  $p < 0.05$ . In all analyses, significance was assessed by the Wald test. Statistical computations were performed using the SAS system for Windows, release 9.1.3/2003 (studies I, II, III, IV, and VI). In study V, statistical computations were performed using the SAS system for Windows, release 8.2/2000.

In **study I**, ORs for psychiatric symptom measures from three separate informants were calculated as continuous variables corresponding to the change of one standard deviation (SD) unit. All statistically significant variables from the univariate analysis were entered into the multivariate model. Because of the hierarchical relationship between Rutter total scores and subscores, two separate multivariate models were performed. The multinomial logistic procedure was also used to study the first-order interactions between the studied variables at age eight. The multiple imputation procedure was used for the uni- and multivariate models to compare the results with not imputing the missing values. The imputation was performed using the Proc SAS/MI's using the Markov chain Monte Carlo technique (MCMC) with five imputations.

In **study II**, ORs for psychiatric symptom measures from three separate informants were calculated as continuous variables corresponding to the change of one standard deviation (SD) unit. All ORs were adjusted for family structure and parents' educational level. To study the predictive associations at the end of the continuum of each measure, ORs were also calculated as categorical variables. For each Rutter scale and CDI, a 90<sup>th</sup> percentile cut-off on each symptom scale was used. A multivariate model including all hypothesized variables was performed using both categorical and linear variables. The multinomial logistic procedure was used to study the first-order interactions between the studied variables at age eight. To study the magnitude and the direction of detected interactions, a *post hoc* analysis was performed: the associations between hyperactive and emotional problems, and educational level of the father were calculated for boys with probable clinical depression (16 points or more in the CDI score) versus low CDI score (0-15 points). The associations for symptom measures (hyperactive and emotional problems) were calculated, corresponding to the change of one standard deviation (SD) unit.

In **study III**, information from parent and teacher questionnaires was pooled and symptom variables were used as categorical with 50<sup>th</sup> and 90<sup>th</sup> percentile cut-offs. In an additional analysis, the ORs for symptom variables were also computed from parameters of the linear model with continuous variables, so that each OR indicated a change of one standard deviation (SD) unit. The comparisons were also done by adjusting for family structure and parental education level.

The multinomial logistic procedure was used to study the first-order interactions between the studied variables at age eight.

In **study IV**, symptom variables were used as categorical with 90<sup>th</sup> percentile cut-offs. Furthermore, the strength of associations was also quantified with the number needed to treat (NNT) (Kraemer et al. 2003). Additionally, all ORs were adjusted for family structure and parents' educational level, and adjusted with total symptom count, and paired comparisons were performed between the psychopathology types. Multinomial logistic regression analysis was performed to study first-order interactions.

In **study V**, YASR symptom variables were used as categorical with 90<sup>th</sup> percentile cut-offs. All statistically significant explanatory variables from the univariate analysis were entered in the final multivariate logistic regression analysis. As the YASR syndromes scales are included in the YASR total score and the subscales, three separate models were performed, and only the model with YASR syndrome scales was reported. Two-sided interactions between the statistically significant variables from the multivariate analysis were tested using models with forward and backward selection. No clear interactions were detected, as there was a notable instability between the models.

In **study VI**, psychiatric diagnoses were analyzed as categorical response variables. Cumulative logistic regression was used to analyze the associations between the explanatory and response variables. Multivariate analyses included all crime types and data on parental education level in childhood.

#### **4.1.1 Ethical considerations**

Written consent was obtained from the parents in 1989 and from the participants in 1999. In 1989, the ethics committees in all five University Hospitals (Helsinki, Kuopio, Oulu, Tampere, Turku) approved the research plan. Furthermore, the Ministry of Education, the Ministry of Health, the Trade Union of Education in Finland, and the school boards in all communities involved approved the study plan in 1989.

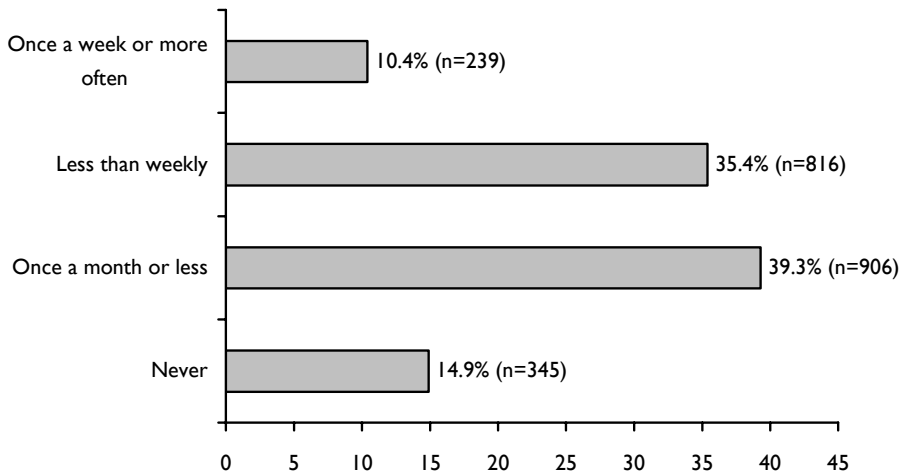
In 1999, the Joint Commission on Ethics of Turku University and Turku University Central Hospital and the Ethics Committee of the Finnish Military Forces approved the research plan. The Ministry of the Interior and the Finnish Defence Forces granted access to the registers. The Office of the Data Protection Ombudsman in Finland approved the register linkage for **study VI**. The combined information from the registers was analyzed in such a way that the subjects could not be identified.

## 5 RESULTS

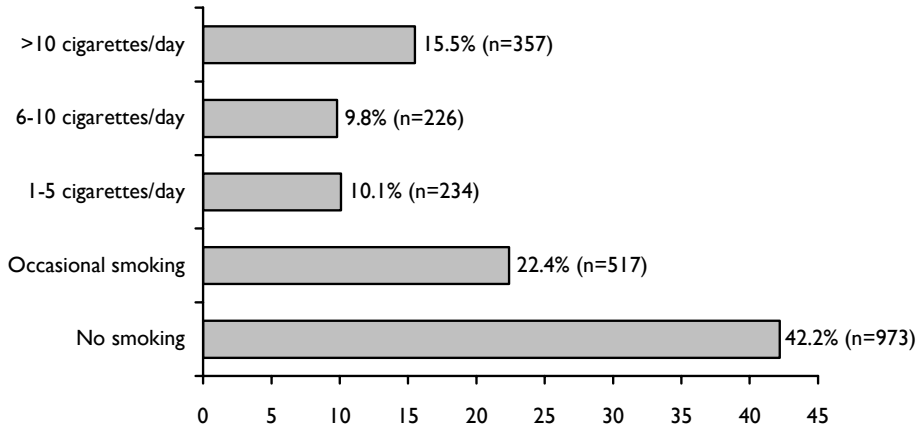
### 5.1 Prevalences

**Prevalences of substance use at age 18 are presented in Figures 11-14.** According to the military register, there were 48 subjects (1.8%) with a diagnosed substance use disorder (SUD). The data from the National Police Register during the years 1998-2001 (age 16-20 years) included altogether 193 **drug offences**, committed by 106 subjects (3.6% of the original sample in 1989). These offences were classified by the police into three specific categories: unlawful use of narcotics (n=14), narcotics offence (n=171), and aggravated narcotics offence (n=8). There were altogether 152 **drunk driving offences**, committed by 139 subjects (4.7% of the original sample in 1989).

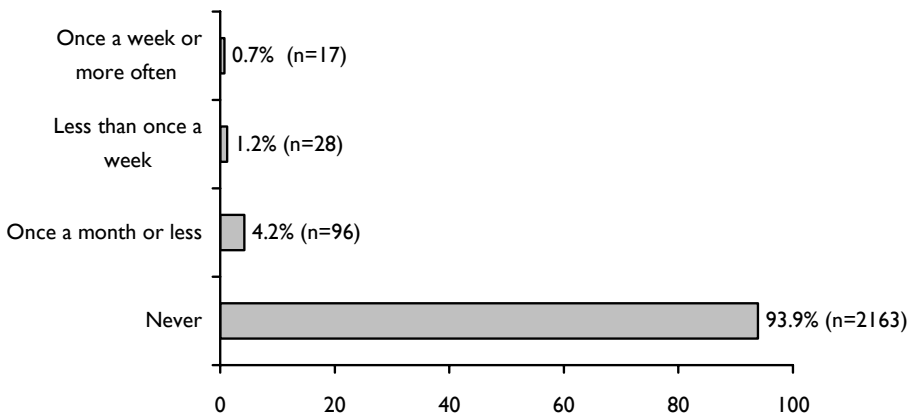
**Figure 11. Prevalence (%) responses to the question "How often have you been drunk during the past six months?" (n=2306)**



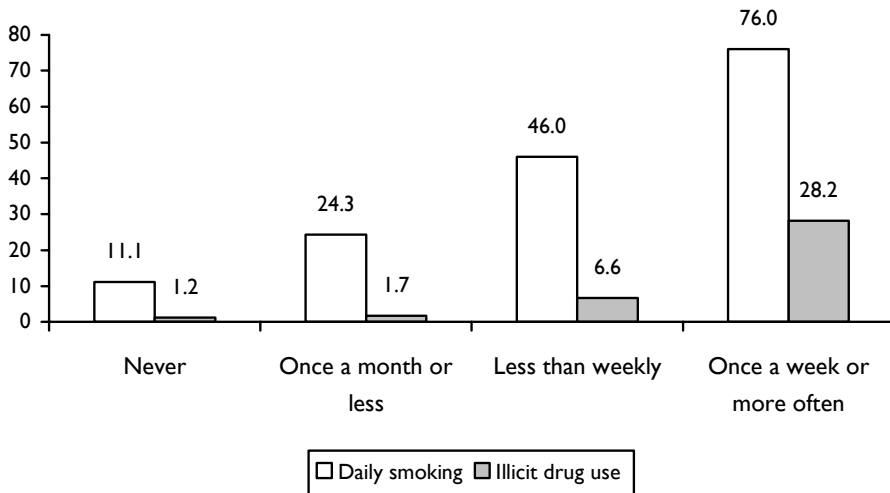
**Figure 12. Prevalence (%) responses to the question "How often have you been smoking during the past six months?" (n=2307)**



**Figure 13. Prevalence (%) responses to the question "How often have you used drugs during the past six months (such as cannabis, amphetamine, intoxicating drugs)?" (n=2304)**



**Figure 14. Prevalence (%) of smoking and illicit drug use and level of drunkenness frequency at age 18**



## 5.2 Childhood predictors for drunkenness (Study I)

In the multivariate analysis, only teacher-reported psychiatric symptoms at age eight independently predicted frequent drunkenness (once a week or more often) at age 18. Hyperactive problems predicted both occasional, i.e. less than weekly and frequent drunkenness. Conduct problems at age eight predicted only frequent drunkenness. High teacher-reported scores of emotional problems predicted lower occurrence of drunkenness-related alcohol use. (Table 12, Study I: Table 1). The results were very similar using the multiple imputation procedure.

**Table 12. Childhood predictors for drunkenness<sup>1</sup>**

Variable	Occasional	Frequent
	OR 95%CI	OR 95%CI
Family structure other than two biological parents	1.2 (0.8-1.8)	<b>1.7 (1.00-2.9)</b>
Teacher-reported conduct problems	1.0 (0.9-1.2)	<b>1.1 (1.00-1.3)</b>
Teacher-reported hyperactive problems	<b>1.2 (1.1-1.4)</b>	<b>1.2 (1.1-1.5)</b>
Teacher reported emotional problems	<b>0.8 (0.7-0.9)</b>	<b>0.8 (0.7-0.96)</b>

<sup>1</sup> Family background, conduct problems according to parent's report, hyperactive, conduct and emotional problems according to teacher's report, and the child's self-reported CDI, bullying others and psychosomatic symptoms were included in the multivariate model. Those with no drunkenness were the reference group (OR=1.0). Only statistically significant ( $p<0.05$ ) associations are shown.

Among the 10% with the highest scores on the conduct problem scale according to the teacher's report, 16.9% reported frequent drunkenness at age 18 vs. 9.7% of the boys below the 90<sup>th</sup> percentile (OR 3.0, 95%CI 1.6 – 5.6,  $p<0.001$ ). Respectively, of the 10% of boys with the highest scores on the hyperactive scale according to the teacher's report 16.9% reported frequent drunkenness vs. 9.5% of the boys below the 90<sup>th</sup> percentile (OR 3.3, 95%CI 1.8-5.9,  $p<0.001$ ). In the non-imputed data, a first-order interaction was found between family structure



and teacher-reported hyperactive problems ( $p=0.03$ ). When the teacher-reported conduct and hyperactive problems were assessed according to family structure, conduct problems predicted frequent drunkenness among those with intact family structure (OR 1.5, 95%CI 1.2 - 2.0,  $p=0.007$ ). Hyperactive problems among those with non-intact family structure predicted both occasional (OR 2.4, 95%CI 1.3-4.3) and frequent (OR 2.8, 95%CI 1.5-5.5;  $p=0.006$ ) drunkenness. After imputing the missing values, no statistically significant interactions were found in the models with the Rutter total scores, nor with the Rutter subscores.

### 5.3 Childhood predictors for cigarette smoking (Study II)

Hyperactivity and self-reported depressive symptoms predicted moderate daily and heavy daily smoking. Conduct problems predicted heavy daily smoking at age 18. Emotional problems predicted lower occurrence of occasional and daily smoking. These predictive associations were strongest for those with high level of psychiatric symptoms and smoking frequency. A high level of depressive symptoms in conjunction with low educational level of the father predicted both moderate and heavy daily smoking. Emotional problems with a high level of depressive symptoms decreased the risk of heavy daily smoking at age 18. In general, teacher reports had a better predictive power than parent reports for subsequent smoking. (Table 13, Study II: Table 4).

**Table 13. Independent<sup>1</sup> predictors at age eight for smoking at age 18.**

Variable at age eight	Occasional smoking at age 18	Smoking < 10 cigarettes a day at age 18	Smoking >10 cigarettes a day at age 18
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Family structure other than two biological parents	0.9 (0.5-1.5)	<b>1.8 (1.2-2.5)</b>	1.4 (0.8-2.4)
Mother's low educational level	1.0 (0.8-1.4)	1.2 (0.9-1.7)	<b>1.6 (1.1-2.3)</b>
Father's low educational level	<b>0.7 (0.5-0.9)</b>	1.2 (0.8-1.7)	<b>1.6 (1.00-2.5)</b>
Parent-reported conduct problems	1.0 (0.8-1.1)	1.0 (0.9-1.2)	<b>1.2 (1.02-1.4)</b>
Teacher-reported hyperactive problems	1.2 (0.96-1.4)	<b>1.2 (1.04-1.5)</b>	<b>1.3 (1.1-1.6)</b>
Teacher-reported emotional problems	<b>0.8 (0.7-0.9)</b>	<b>0.8 (0.7-0.9)</b>	<b>0.8 (0.6-0.9)</b>
Child's self-reported depressive symptoms	1.0 (0.9-1.1)	<b>1.2 (1.02-1.3)</b>	<b>1.2 (1.1-1.4)</b>

<sup>1</sup> The model included maternal and paternal education level, family structure, school performance, parent and teacher reports of conduct, hyperactive and emotional symptoms, and child self-reported depressive symptoms. Total number of subjects ( $n=1803$ ). Those with no smoking were the reference group (OR=1.0). Only statistically significant ( $p<0.05$ ) associations are shown.

Depressive symptoms had an interaction with father's educational level, teacher-reported hyperactive, and teacher-reported emotional problems. To study the magnitude and the direction of these interactions, a *post hoc* analysis was performed: the associations between hyperactive and emotional problems, and educational level of the father were calculated for boys with probable clinical depression (16 points or more in the CDI score) versus low CDI score (0-15 points). The associations for symptom measures (hyperactive and emotional problems) were calculated, corresponding to the change of one standard deviation (SD) unit. Depressed boys of low educated fathers were at risk of moderate daily (OR=7.1, 95%CI 1.5-34.5), and heavy daily smoking (OR=12.4, 95%CI 1.5-102.0,  $p=0.018$ ). Hyperactive problems with a high level of depressive symptoms associated with heavy smoking (OR=1.6, 95%CI 1.1-2.6,  $p=0.129$ ). Moderate (OR=0.6, 95%CI 0.4-0.9), and heavy daily smoking (OR=0.5, 95%CI 0.3-0.7,  $p=0.007$ ) was less prevalent among boys with a high level of depressive symptoms and emotional problems.

## 5.4 Self-reported illicit drug use and police-registered drug offending (Study III)

None of the childhood symptom variables at age eight predicted subsequent self-reported illicit drug use without police-registered drug offending. Police-registered drug offending, in turn, was predicted by child's moderate and severe conduct and hyperactive problems. Both self-reported illicit drug use and police-registered drug offending were predicted by non-intact family structure at age eight (**Table 14, Study III: Table 1**).

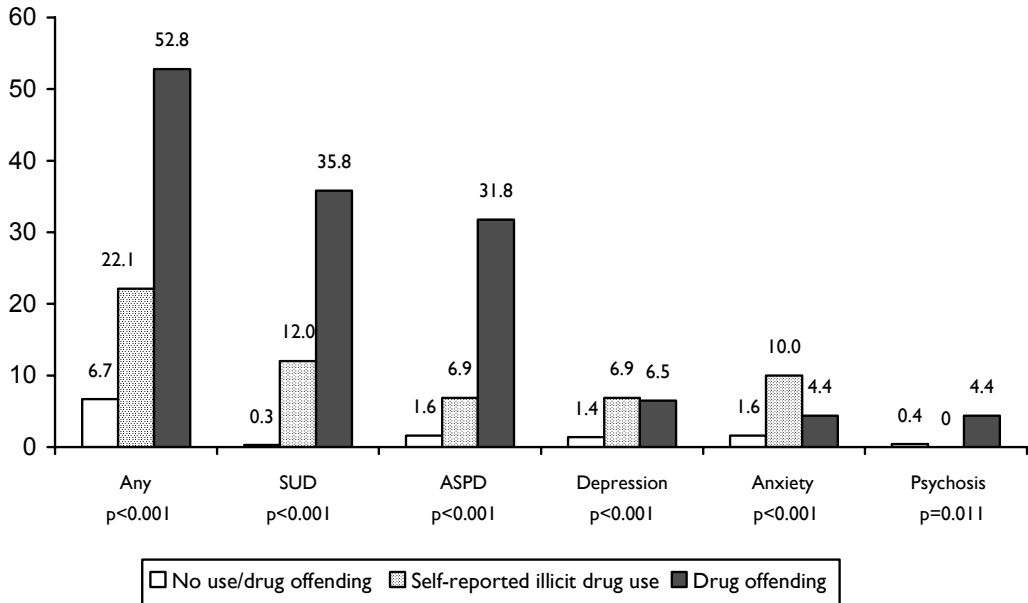
**Table 14. Childhood predictors for involvement with illicit drugs**

Variable	Self-reported use	Drug offending
	OR 95%CI	OR 95%CI
Family structure other than two biological parents	<b>1.7 (1.03-2.7)</b>	<b>3.3 (2.1-5.2)</b>
Conduct problems <sup>1</sup>		
50-90 <sup>th</sup> percentile	1.4 (0.9-2.2)	<b>2.7 (1.6-4.5)</b>
>90 <sup>th</sup> percentile	0.9 (0.4-2.2)	<b>4.3 (2.2-8.3)</b>
Hyperactive problems <sup>1</sup>		
50-90 <sup>th</sup> percentile	0.9 (0.6-1.4)	<b>2.8 (1.7-4.7)</b>
>90 <sup>th</sup> percentile	0.5 (0.2-1.3)	<b>4.0 (2.1-7.6)</b>

<sup>1</sup> Adjusted with family structure and parental education level. Those with no self-reported illicit drug use or drug offending were the reference group (OR=1.0). Only statistically significant ( $p < 0.05$ ) associations are shown.

In early adulthood, involvement with illicit drugs correlated strongly with having a psychiatric diagnosis (**Figure 15, Study III: Table 2**), and the associations were more evident among the drug offenders. According to the military register, 34% of the subjects with any psychiatric disorder either reported using illicit drugs or were registered for a drug offence. Respectively, 22% of the self-reporters, and 53% of the drug offenders had a psychiatric diagnosis as young adults. Depression (OR=5.3, 95%CI 2.1-13.5,  $p < 0.001$ ) and anxiety disorders (OR=7.4, 95%CI 3.4-16.3,  $p < 0.001$ ) associated more strongly with self-reported use compared to non-users and drug offenders. Also APD (OR=4.7, 95%CI 1.9-11.7,  $p < 0.001$ ) and SUD (OR=51.4, 95%CI 17.2-153.0,  $p < 0.001$ ) associated with self-reported use. Compared to self-reported use, associations were stronger between drug offending and APD (OR=22.5, 95%CI 11.3-45.0,  $p < 0.001$ ); SUD (OR=158.0, 95%CI 56.1-445.0,  $p < 0.001$ ), and psychotic disorder (OR=12.2, 95%CI 2.4-62.1,  $p = 0.011$ ).

**Figure 15. Prevalences (%) of psychiatric disorders in young adulthood among males with illicit drug involvement**



## 5.5 Childhood psychopathology types (Study IV)

Of childhood psychopathology types, the conduct-emotional (C-E) type associated most strongly with subsequent substance-use-related outcomes. The C-E type predicted frequent drunkenness, daily smoking, SUD, drug offending, and drunk driving. The conduct-only type predicted daily smoking and drunk driving. The attention, i.e. hyperactive type predicted daily smoking and drug offending. Children of the invisible type were at risk of frequent drunkenness and daily smoking. The pure emotional type showed no predictive association with substance-related outcomes. Similarly, illicit drug use at age 18 was not predicted by any of the comorbid psychopathology groups (Table 15, Study IV: Table 2).

**Table 15. Childhood psychopathology types and substance-use-related outcomes in early adulthood<sup>1</sup>**

Variable	Frequent drunkenness OR 95%CI	Daily Smoking OR 95%CI	Illicit drug use OR 95%CI	SUD OR 95%CI	Drunk driving OR 95%CI	Drug offence OR 95%CI
Conduct-Emotional	<b>2.8 (1.6-5.1)</b>	<b>3.4 (2.1-5.6)</b>	0.7 (0.2-2.4)	<b>5.6 (2.3-13.4)</b>	<b>4.2 (2.4-7.2)</b>	<b>3.6 (1.8-7.4)</b>
Conduct-only	1.7 (0.98-3.1)	<b>1.8 (1.2-2.6)</b>	1.4 (0.7-3.0)	2.3 (0.8-6.7)	<b>2.4 (1.4-4.3)</b>	1.8 (0.8-4.1)
Attention	1.4 (0.7-3.0)	<b>2.1 (1.3-3.4)</b>	0.8 (0.2-2.5)	2.4 (0.7-8.3)	1.3 (0.6-3.1)	<b>3.5 (1.7-7.4)</b>
Emotional-only	1.4 (0.8-2.2)	0.8 (0.6-1.2)	1.5 (0.8-2.6)	1.0 (0.3-3.4)	0.4 (0.2-1.1)	1.1 (0.5-2.4)
Invisible	<b>1.8 (1.1-3.1)</b>	<b>1.7 (1.2-2.5)</b>	1.6 (0.8-3.1)	1.0 (0.2-4.2)	0.8 (0.-1.9)	0.9 (0.3-2.5)

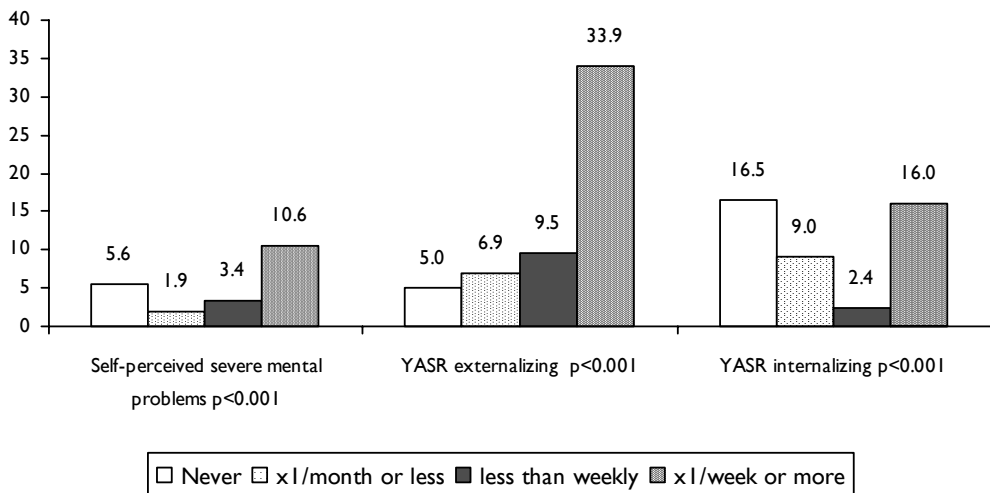
<sup>1</sup> Results from the univariate analysis. In each category, those with no substance-use-related outcome in question were the reference group (OR=1.0). Only statistically significant (p< 0.05) associations are shown.

## 5.6 Cross-sectional associations of drunkenness at age 18 (Study V)

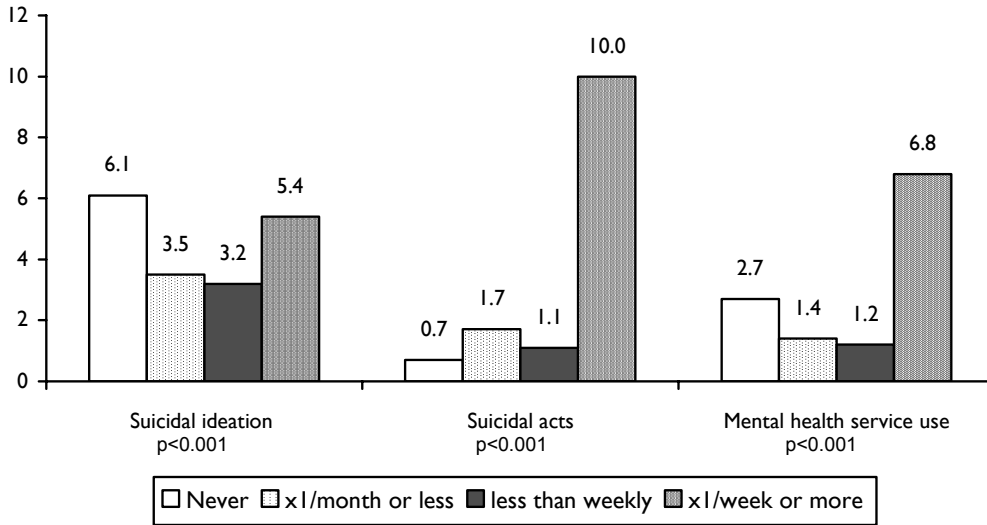
Drunkenness associated linearly with daily smoking and illicit drug use (**Figure 14, Study V; Table 1**). In addition, parent's divorce, not living with parents, and having a regular relationship had a linear association with drunkenness frequency. Occupational and educational problems associated only with frequent drunkenness, i.e. once a week or more often (**Study V; Table 1**). A J-curve phenomenon related to drunkenness frequency can be observed in **Figures 16 and 17**: Suicidal ideation, internalizing problems on the YASR scale (above 90<sup>th</sup> percentile), and self-perceived severe mental problems were more common among boys not reporting drunkenness-related alcohol use compared to those with occasional drunkenness. In the univariate analysis, *occasional drunkenness* (i.e. drunkenness once a month or less or less than once a week) was associated with better adaptive functioning and psychosocial well-being. Lower occurrence of self-reported severe mental health problems and YASR total score, and YASR internalizing problems were detected among boys reporting drunkenness once a month or less. Among boys reporting drunkenness less than once a week, a lower occurrence of suicidal ideation and YASR internalizing syndromes was detected compared to other drunkenness frequency categories. Of the YASR subsyndrome scales, withdrawal associated negatively with drunkenness in general. In addition, the anxious/depressed scale and thought problems had a negative association with occasional drunkenness. *Frequent drunkenness* associated strongly with externalizing problems on the YASR scale. Of YASR syndrome scales, frequent drunkenness associated with somatic complaints, attention and thought problems, and intrusive, aggressive, and delinquent behaviours.

Overall, use of services for mental health problems during the previous 12 months was scarce (2.1%). Only five subjects (0.2%) reported seeking help from substance use treatment settings. Of those frequently drunk, 6.8% reported seeking help for their mental health problems. Frequent drunkenness was found to be common (33.3%) among mental health service users, and those with frequent drunkenness had been seeking help for their mental health problems more often compared to other groups of drunkenness frequency (**Study VI; Tables 1-2**).

**Figure 16. Prevalence (%) of psychopathology variables among 18-year-old males with drunkenness**



**Figure 17. Prevalence (%) of suicidal ideation, suicidal acts and mental health service use among 18-year-old males with drunkenness**

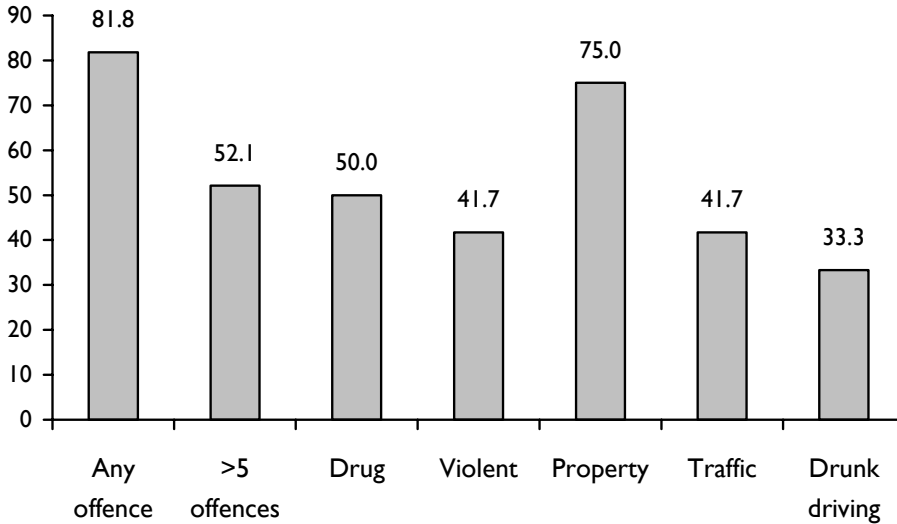


In the **multivariate analysis (Study V; Table 3)**, having more than one friend associated with drunkenness less than weekly (OR=5.1, 95%CI 2.-21.9), and frequent drunkenness (OR=18.2, 95%CI 1.9-173.5, p<0.001). Having a regular relationship associated with all levels of drunkenness, (OR=2.9, 95%CI; OR=3.5, 95%CI 2.3-5.4; OR=4.1, 95%CI 2.4-7.0, p<0.001). Daily smoking associated with all levels of drunkenness (OR=3.2, 95%CI 1.9-5.2; OR=12.3, 95%CI 7.4-20.2; OR=35.9, 95%CI 17.6-73.6, p<0.001). Delinquent behaviour (OR=11.5, 95%CI 2.4-54.8, p<0.001) and illicit drug use (OR=11.6, 95%CI 2.5-53.5, p<0.001) associated only with frequent drunkenness. Occasional drunkenness had a negative association with poor friendship quality (OR=0.4, 95%CI 0.2-0.7; OR=0.3, 95%CI 0.1-0.7, p=0.019).

## 5.7 Substance use disorder (SUD) and level of offending (Study VI)

As presented in **Figure 18**, offending at age 16-20 years was highly prevalent among those with a SUD according to the military register at age 18-23 years. After adjusting with other crime types and parental education level at age eight, SUD associated independently with drug offending (OR=15.0, 95%CI 6.6-34.0, p<0.001), and property crime (OR=14.7, 95%CI 6.4-33.9, p<0.001) (**Study VI: Tables 2 and 3**).

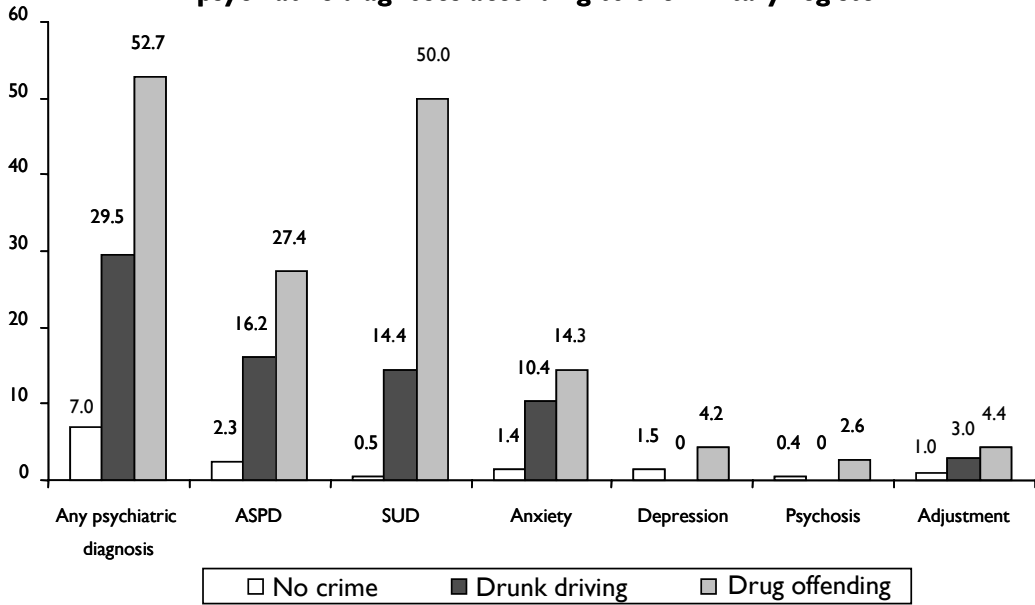
**Figure 18. Prevalence (%) of offences among those with SUD according to the military register (n=48)**



## 5.8 Substance-use-related crime and psychiatric diagnoses (Study VI)

The drug offenders were psychiatrically more impaired than the drunk drivers (**Study VI; Tables 2 and 3**). The most common diagnoses were SUD and APD. After adjusting with other crime types and parental education level at age eight, drunk driving did not independently associate with psychiatric disorders. Drug offending was associated with having any psychiatric disorder (OR 5.0, 95%CI 3.0-8.3,  $p<0.001$ ), APD (OR=8.4, 95%CI 5.0-17.5,  $p<0.001$ ), SUD (OR=15.0, 95%CI 6.6-34.0,  $p<0.001$ ), and psychotic disorder (OR=6.4, 95%CI 1.2-35.5,  $p<0.033$ ). Prevalences of psychiatric diagnoses according to the military register among drug offenders and drunk drivers are presented in **Figure 19**.

**Figure 19. Prevalence (%) of drunk driving, drug offending, and psychiatric diagnoses according to the military register**



## 6 DISCUSSION

In this thesis, I have studied predictors and correlates of substance-use-related behaviours among Finnish young men. The study design was a nationwide longitudinal birth cohort study from age eight to early adulthood. Data were collected using questionnaires at age eight from multiple informants (parents, teachers, boys themselves). The follow-up was conducted using questionnaires at age 18, and from military and police registries in early adulthood. A central finding of this thesis is that substance-use-related outcomes accumulate in boys with psychiatric problems both in childhood and in early adulthood.

### 6.1 Discussion of the results

#### 6.1.1 Prevalences

**Drunkenness** as a drinking habit is common among 18-year-old Finnish boys. Three out of four reported occasional drunkenness, i.e. less than weekly. One out of ten was drunk at least once a week. Of all the boys, 14.9% reported not being drunk within the past six months. Figures on prevalence of self-reported drunkenness are consistent with other studies done in Finland and elsewhere (Andersen et al. 2003, Lintonen et al. 2000, Rimpelä et al. 2005, Pirskanen 2007). Concerning **cigarette smoking frequency**, 35.4% smoked daily, and 15.5% were daily heavy smokers, i.e. smoking more than ten cigarettes a day. **Illicit drug use** was reported by 6.1% of the responders. These results are consistent with prior Finnish studies (Rimpelä et al. 2005, Pirskanen 2007).

The prevalence of **substance use disorder (SUD)** according to the Military Register at age 18 to 23 years was 1.8%. The present SUD rate is lower than in previous Finnish studies (Aalto-Setälä et al. 2001) and elsewhere (Armstrong and Costello 2002). It is likely that a significant amount of the SUD diagnoses are missed during the diagnostic evaluation process at the military call-up procedure and during military service.

Of the subjects, 5.1% had a police-registered **drunk driving** offence. In the Northern Finland Birth Cohort Study, 6.8% of males committed at least one drunk driving offence by the age of 32 (Riala et al. 2004). **Drug offending** has been very little studied. In the present study, altogether 3.6% of the boys from the original sample had been registered for a drug offence. Typically, previous studies have looked at offending patterns in captive populations, such as those in drug treatment or arrestees, and therefore provide a restricted view of the complex relationships between drugs and crime in a total population (EMCDDA 2006, Deng et al. 2001). Kinnunen (2001) reported in a study of all Finnish males born in 1962, that 0.8% of the age cohort had been convicted for a drug offence. The prevalence of drug offending in Finland was found to increase by 73% between the years 1995 and 2000 (Kinnunen 2001), and thus the present cohort born in 1981 may have committed more drug offences compared to the older age cohort. In a study from New Zealand, 5.2% of the original sample had been either arrested or convicted for a cannabis offence (Fergusson et al. 2003d). However, the cross-national comparisons may be exigent, as the drug laws vary by nation.



## 6.1.2 Childhood predictors

### Key findings

- Childhood conduct problems predicted frequent drunkenness, heavy daily smoking, and substance-use-related crime.
- Hyperactivity predicted occasional and frequent drunkenness, daily smoking, and drug offending.
- Self-reported depressive symptoms predicted moderate and heavy daily smoking. Among boys with a high level of depressive symptoms, low paternal education level further increased the risk for daily heavy smoking.
- Comorbid conduct-emotional problems predicted frequent drunkenness, daily smoking, SUD, drunk driving and drug offending.
- Parent and teacher-reported emotional problems predicted lower occurrence of drunkenness and smoking.

#### 6.1.2.1 Conduct problems

Childhood conduct problems predicted, independently of other childhood psychopathology variables and family background, frequent drunkenness, heavy daily smoking, and substance-use-related crime, further confirming the results from the previous longitudinal studies (Kellam et al. 1980, Henry et al. 1993, Costello et al. 1999, King et al. 2004, Fergusson et al. 2007a, Elkins et al. 2007).

**In study I**, childhood conduct problems predicted frequent, but not occasional drunkenness. The association between alcohol use and childhood conduct problems has been reported in various previous studies (see, for example, Kellam et al. 1980, Boyle et al. 1993, Henry et al. 1993, Disney et al. 1999, White et al. 2001, King et al. 2004, Molina and Pelham, 2003). Recently, Fergusson et al. (2007a) have reported that childhood conduct problems did not predict alcohol use and AUDs in early adulthood. Here, the lack of association between childhood conduct problems and occasional drunkenness may reflect the normativeness of occasional drunkenness as an alcohol use habit at age 18 (see also discussion in 6.1.4.1).

**In study II**, childhood conduct problems predicted heavy daily smoking, further confirming results from the previous longitudinal studies (see, for example, Kellam et al. 1980, Lynskey and Fergusson 1995, King et al. 2004, Elkins et al. 2007). Some previous studies have also proposed a different direction of causality: Brook et al. (1998) have reported that conduct disorder did not predict smoking, but smoking anticipated later APD. According to the self-medication hypothesis, smoking reduces impulsivity, which may in part explain the association between smoking and conduct problems (Sacco et al. 2004). Furthermore, smoking has been found to associate with peer deviance (Fergusson and Horwood 1999), and it may serve as an expression of detachment and rebellion among boys with behavioural problems.

**In study III**, a high level of childhood conduct problems predicted police-registered drug crime, but not self-reported illicit drug use without drug offending. **In study IV**, pure conduct problems were associated with later drunk driving. The childhood predictors between drug offenders and those who only report using illicit drugs have not been compared in previous research. Also the childhood predictors for drunk driving have also been studied scarcely (Sourander et al. 2006). However, there is a body of evidence that childhood conduct problems

predict experimenting and use of illicit drugs (see, for example, Kellam et al. 1980, Boyle et al. 1993, King et al. 2004, Fergusson et al. 2007a, Odgers et al. 2007). Conduct problems have also been found to predict APD (Caspi et al. 1996, Sourander et al. 2005), and criminality (Fergusson et al. 2005a, Loeber and Farrington. 2000, Sourander et al. 2006). This may in part explain the associations between childhood conduct problems and later substance-use-related crime.

**In study III**, childhood symptomatology did not predict self-reported illicit drug use without drug offending. However, psychiatric problems were prevalent among self-reporters in early adulthood. Drug offending, in turn, associated with psychiatric problems both in childhood and in early adulthood. In early adulthood, APD diagnosis in particular associated with involvement with illicit drugs (see also discussion in 6.1.4.2). Furthermore, childhood family structure predicted both self-reported use and drug offending. These findings indicate separate developmental pathways leading to entanglement with illicit drugs.

The following explanations for the differences between drug offenders and self-reporters can be hypothesized: (1) Less severe involvement with illicit drugs, such as experimenting, may be influenced mostly by environmental factors, such as peers, or accessibility of illicit drugs, while individual risk factors, such as heritability may contribute to continuation from experimentation to problematic illicit drug use (Rhee et al. 2003). Furthermore, prior studies have not shown any strong link between experimental drug use and offending, but they do tend to show that delinquency often precedes involvement with illicit drugs (EMCDDA 2006). Drug offending seems to associate with both individual and environmental risk factors in childhood, while self-reported use associates only with environmental factors. (2) Individual risk factors arising during adolescent years, but not yet present in childhood, may also add to the risk of experimenting and use of illicit drugs. For instance, adolescent-onset depression or anxiety (Brook et al. 2002) and delinquency (Moffitt 1993, Odgers et al. 2007) have also been found to increase the risk of illicit drug use. This in turn, may be preceded by childhood disadvantages in the social environment e.g. parental divorce (Ge et al. 2006, Gilman et al. 2003). (3) These etiological and temporal differences may also reflect Moffitt's taxonomy of life-course-persistent versus adolescent-onset of antisocial behaviour (Moffitt. 1993, Odgers et al. 2007). Life-course-persistent antisocial behaviour has been shown to associate with both individual (conduct and hyperactive problems, neurodevelopmental deficits and genetic factors) and family adversities early in life, while for adolescent-limited antisocial behaviour these associations are not as obvious (Moffitt et al. 2002, Silberg et al. 2007). Our findings add to the existing evidence distinguishing life-course-persistent and adolescent-onset subtypes of delinquency, and indicate differences in illicit drug involvement in early adulthood between these subtypes. Furthermore, the preventive needs during childhood, and the age period for intervention may be different for boys with divergent substance-use involvement.

In this thesis, conduct problems associated with the most hazardous substance-use-related outcomes. Given the solid evidence from previous studies, childhood conduct problems are one of the central precursors for substance-use-related problems at a young age. However, there is little empirical evidence about the patterns of early- and late-onset delinquent behaviours in relation to substance-use-related harm, and this needs further clarification. For instance, there is little knowledge about the environmental and individual factors determining the course of antisocial behaviours during the lifespan. Rutter (1980) has stated that adolescent problem behaviour associates with a variety of environmental factors, such as family discord, family communication patterns, parental criminality and mental health problems of the parents, poverty and low social status, and the community structure. Future studies should focus on identifying

early risk factors for conduct problems, and on revealing interactions between environmental and individual factors as predictors for later substance-use-related outcomes.

#### 6.1.2.2 *Hyperactive problems*

Hyperactivity independently predicted all levels of drunkenness and daily smoking (**studies I and II**). Furthermore, childhood hyperactivity associated with later police-registered drug offending, but not with self-reported illicit drug use without drug offending (**study III**). These results are in line with previous reports from longitudinal studies indicating that children with ADHD symptoms are at increased risk of more frequent use and substance-use-related problems. (Molina et al. 2003, King et al. 2004, Biederman et al. 2006, Molina et al. 2007, Elkins et al. 2007)

**In study I**, hyperactivity was found to increase the risk of all levels of drunkenness-related alcohol use, regardless of comorbid conduct problems or family background. Some previous reports have considered that childhood hyperactive/attention problems do not predict subsequent alcohol-related problems after comorbidity with co-existing conduct problems have been taken into account (Lynskey and Hall 2001, Fergusson et al. 2007a). However, this was not the case in our study, as the predictive association between hyperactivity and later drunkenness-related alcohol use was stronger compared to conduct problems.

**In study II**, hyperactive problems predicted moderate daily, and heavy daily smoking. Our finding is in line with previous research indicating that children with ADHD symptoms or categorical diagnosis of ADHD are at risk of later cigarette smoking and nicotine dependency (King et al. 2004, Biederman et al. 2006, Fergusson et al. 2007a, Elkins et al. 2007). Our results support the self-medication hypothesis postulating that nicotine enhances concentration in ADHD probands (Sacco et al. 2004). The mechanism for the effect of nicotine on reducing attentional deficits in ADHD may be similar to that of psychostimulants used to treat ADHD, and probably involves enhancement of central dopamine and noradrenaline function (Sacco et al. 2004). It has also been speculated that ADHD symptoms may be a specific risk factor for smoking, whereas the associations between alcohol and drug use may also be explained by other risk factors, such as delinquent behaviour and peer influence (Fergusson et al. 2007a).

**In study III**, childhood ADHD symptoms predicted police-registered drug offending, but not self-reported illicit drug use. The linkages between ADHD problems and later substance use and crime have been found to be mediated by early conduct problems (Disney et al. 1999, Biederman et al. 2006, Fergusson et al. 2007a). It has also been assumed that individuals with comorbid ADHD and CD are at higher risk of substance use and SUD (Biederman et al. 2008). These highly correlated developmental trajectories between childhood hyperactive and conduct problems may explain the discrepant findings across previous studies. However, the analyses of 16 different childhood psychopathology types (**study IV**) did not show any higher predictive value compared to the attention or conduct-only types. Furthermore, in this thesis, childhood hyperactivity was found to be an independent risk factor for all studied substance-use-related outcomes. According to our findings, hyperactive boys are at greater risk of developing substance-use-related problems later in life. Accordingly, the importance of detecting and treating childhood ADHD is highlighted.

#### 6.1.2.3 *Emotional problems*

Adult-reported childhood emotional symptoms, such as low mood, shyness, and withdrawal, predicted lower occurrence of occasional and frequent drunkenness (**study I**), as well as

occasional and daily smoking (**study II**). These results are in line with the results from the Woodlawn Study, where shy boys were shown to have less substance use problems as adults (Fothergill and Ensminger 2006). Similarly, Costello et al. (1999) have reported that children with anxiety disorder initiate smoking later compared to others. In addition, the findings from the Pittsburg Youth Study have shown that substance use is less common among youths with persistent internalizing problems from childhood to adolescence (Loeber et al. 1999).

Also here, the previous studies have provided conflicting results. In the Dunedin Study, the 3-year-old boys rated as behaviourally inhibited (i.e. shy, fearful and easily upset) were found significantly more likely to report alcohol dependence in early adulthood (Caspi et al. 1996). In the Great Smoky Mountain Study, general childhood anxiety symptomatology was found not to be related with initiation of alcohol use, after comorbid depression had been controlled for (Kaplow et al. 2001). When specific anxiety disorders were studied, generalized anxiety disorder was found to increase, and separation anxiety to decrease the risk of initiation of alcohol use (Kaplow et al. 2001). This was contradicted by King et al. (2004): separation anxiety disorder and overanxious disorder at age 11 did not predict substance use initiation, nor use of alcohol, cigarettes or cannabis at age 14.

It seems that various aspects of childhood emotional problems may function differently as precursors for later substance use. However, emotional problems, such as anxiety, may trigger substance use later in life. For example, late-onset alcoholics have been found to drink alcohol to relieve anxiety (Sigvardsson et al. 1996). In late-adolescence, when substance use most commonly associates with socializing with others, withdrawal and shyness may lower the risk of experimenting and using substances. Emotional problems may also have an impact on risky behaviours in general: inhibition at age three years has been found to predict a preference for safe actions over dangerous ones by self-report at age 18 (Caspi et al. 1997). Accordingly, it can be hypothesized that childhood emotional problems increase withdrawal from social relations and decrease risk-taking behaviour, such as substance use.

#### 6.1.2.4 Depressive symptoms

**In study II**, depressive symptoms at age eight predicted daily smoking at age 18, and this association was statistically significant even after controlling for family background and conduct and ADHD symptoms. Previous studies providing data on childhood depression, i.e. before age 12 years, are scarce, and these few studies have provided conflicting results. In addition, previous studies including data on childhood depressiveness have estimated either experimenting or a lower level of smoking than daily use or nicotine dependence, and have not extended their follow-up beyond five years (Dierker et al. 2007, King et al. 2004, Wu and Anthony 1999). Some studies have reported that depression predicts experimenting or a lower level of smoking than daily smoking (King et al. 2004), while some studies have reported that depressive symptoms predict smoking only among girls (Dierker et al. 2007). Wu and Anthony (1999), in turn, reported that smoking causes depression, but not vice versa.

The association between childhood depressive symptoms and smoking later in life is subject to multiple interpretations. For instance, nicotine has been hypothesized to have antidepressant effects by increasing serotonergic function (Fowler et al. 1996). The effect of nicotine may be reinforcing for depressed individuals with chronically low levels of serotonin, contributing to depressed mood (Fowler et al. 1996, Watkins et al. 2000). Furthermore, persons who experience their first exposure to nicotine as relaxing have been found to be at an elevated risk for becoming nicotine dependent (Pomerleau et al. 1998). Some studies, in turn, have proposed that smoking increases the risk for subsequent depression (Wu and Anthony 1999, Goodman

and Capitman 2000, Klungsöyr et al. 2006, Korhonen et al. 2007). Furthermore, depression may perpetuate smoking, i.e. those with a higher level of depressed mood may be more likely to continue smoking once having started (Breslau et al. 1998).

In the present thesis, low paternal education level was shown to further increase the risk for daily heavy smoking among boys with a high level of depressive symptoms. This indicates that childhood environmental factors conjoined with depressive symptoms promote developing a habit of regular smoking later in life. In future research, when studying causality between smoking and depressive symptoms, both genetic (Audrain-McGovern et al. 2004, Kendler et al. 1993) and environmental factors (Fergusson et al. 2003b, Jefferis et al. 2003, Tyas and Pederson 1998) should be taken into account.

**In study I**, depressive symptoms were also associated with frequent drunkenness in the univariate analysis, but not after adjusting for confounding variables. **In study IV**, self-reported depressive symptoms, also when not noticed by adults, predicted frequent drunkenness. These findings are in congruence with results from previous longitudinal studies (King et al. 2004, Kaplow et al. 2001, Wu et al. 2006). Kumpulainen (2000) reported in a Finnish follow-up study from age 12 to age 15 that self-reported depressive symptoms predicted subsequent heavy alcohol use among girls, but not among boys.

The causal associations between depression and later substance use are complex, and several questions still remain. For instance, is it a higher level of depressed mood that causes substance use? Or does substance use cause depressed mood? Or are those with a higher level of depressed mood more likely to continue using substances once substance use starts? Most likely, all three of these cause-effect relationships are operative. Also the gender-specific associations between childhood depressive symptoms and later substance use need further clarifying.

#### 6.1.2.5 *Comorbid conduct-emotional problems*

**In study IV**, the novel approach to study comorbidity by combining childhood features and information from three informants provided an excellent method to detect those boys at the greatest risk for high levels of substance use and substance-use-related crime in early adulthood. The comorbid conduct-emotional psychopathology type predicted frequent drunkenness, daily smoking, SUD, drunk driving and drug offending. The lack of association between childhood psychopathology and self-reported illicit drug use may be due to the small number of subjects in each class, but it also reflects the findings from **study III** comparing childhood predictors for subsequent involvement with illicit drugs. According to our findings, substance-use-related outcomes cluster particularly in this subgroup of boys.

Our results are in line with earlier, although limited, findings from longitudinal studies showing that comorbid conduct-emotional symptoms predict subsequent substance-use-related problems (Ensminger et al. 2002, Pardini et al. 2007, Loeber et al. 1999, Pardini et al. 2007). It has been suggested that mood dysregulation (expressed as depressive mood, anxiety, or shy or withdrawn behaviour) affects substance consumption among delinquent boys, perhaps through self-medication (Loeber et al. 1999). Additionally, co-occurring depressive symptoms and conduct problems have been found to be more prevalent in the subgroup of alcoholics with an early onset of alcoholism (Buydens-Branchey et al. 1989) **In study IV**, the comorbid C-E psychopathology type had the most adverse outcomes in addition to the substance-use-related outcomes, emphasizing the preventive needs of this group of boys potentially at risk of marginalization.

The importance and mechanisms of childhood comorbid psychopathology on substance use has been sparsely studied. Little is known about what kind of emotional psychopathology in particular, conjoined with conduct problems, increases the risk of later substance use. In addition, concepts of childhood bipolar disorder and severe mood dysregulation (SMD) need further clarification. Leibenluft (2003) has described a concept of SMD characterized by an abnormal baseline mood (e.g. irritability, anger, and/or sadness), hyperarousal (e.g. restlessness) and increased reactivity to negative emotional stimuli (e.g. temper outbursts). To date, the prospective associations between childhood bipolar disorder or SMD and later substance use have not been studied.

#### 6.1.2.6 Family background

Consistent with previous studies, **family structure** other than two biological parent predicted frequent drunkenness (McGee et al. 2000, Fergusson. 2007c, Weitoft et al. 2003), daily smoking (Tyas and Pederson 1998), and involvement with illicit drugs (McArdle et al. 2002, Sutherland and Shepherd 2001, Weitoft et al. 2003). In previous research, also marital changes during mid- to late childhood have been found to predict offspring's substance use (Hayatbakhsh et al. 2006). Additionally, parental divorce in early childhood has been found to increase the risk of a higher lifetime risk of depression (Gilman et al. 2003), and may mediate the risk of later substance use. However, the association between family structure and later substance use most probably reflects other factors influencing substance use of the offspring, such as parental attitudes towards substance use, parenting practices, parental mental problems, and family discord (Fergusson et al. 2007c). Accordingly, Van Voorhis et al. (1988) have stated that 'bad homes' not 'broken homes' place youth at risk. In our study, the array of studied family background variables was limited. Therefore, our results concerning the family structure should be interpreted with caution.

Low **parental education level** associated with heavy daily smoking. The association between smoking and low educational level as well as low socio-economic status has been established in numerous previous studies (see, e.g. Jefferis et al. 2003, Tyas and Pederson 1998). As discussed above (see, 6.1.2.4), father's low educational level was found to mould the association between smoking and depression.

Parental educational level may also have an impact on the type of the community (rich or poor) the adolescents are living in (Sellström and Bremberg 2006), which may have an impact on the availability of substances. Furthermore, police activities may vary in these dissimilar environments (Nandi et al. 2006). In a rich community adolescents are more likely to use illicit drugs at home. In a poor community, adolescents use drugs on the street. Therefore, the police in these surroundings may more easily detect illicit drug use.

### 6.1.3 Informants

#### Key findings

- Teacher-reported externalizing problems had better predictive power for drunkenness and cigarette smoking at age 18 than parent reports of these symptoms.
- Teacher-reported emotional problems had better predictive power for lower occurrence of drunkenness frequency and cigarette smoking at age 18 than parent reports of these symptoms.
- Self-reported depressive symptoms, also when not noticed by parents or teachers, had predictive value for later substance use.

The teacher reports of a child's problem behaviour, both hyperactive and conduct problems, was shown to have better predictive value compared to parent reports for later drunkenness and cigarette smoking (**studies I and II**). This is in line with a previous Finnish study showing that teacher-rated externalizing problems at age 12 predict heavy alcohol use at age 15 among boys (Kumpulainen and Roine 2002). In **studies I and II**, teacher, but not parent reports of child's emotional problems associated independently with a lower occurrence of drunkenness and smoking at age 18.

The differences between adult informants as predictors for later substance use may be a consequence of the following: (1) School environment and classroom situations are demanding, particularly for children with neuropsychiatric problems, such as hyperactivity, poor concentration, impulsivity and aggressive behaviour. Therefore, teachers encounter children in an environment which may predispose to problem behaviours. The home environment may be more flexible to children's needs. Children with hyperactive or conduct problems may not necessarily face the same demands at home compared to school. In previous research, it has been well established that the situations in which the observations are made vary, as do the relationships between the child and the reporter, leading to different observations (Achenbach et al. 1987, Kumpulainen et al. 1999). In a previous report from the present study cohort, boys were reported to show different symptoms at school and at home: parents reported more neurotic/internalizing symptoms like being worried and fearful in boys, whereas teachers reported hyperactive symptoms (Kumpulainen et al. 1999). (2) Teachers encounter a larger number of children at school compared to most parents. Thus, teachers may be better able to detect deviant behaviour when they can compare children with each other. (3) Teachers may detect behavioural problems in social situations, while parent-reported symptoms may be based more on personal contact with the child. For example, bullying may be related only to social situations occurring at school, but may not be present at home. Furthermore, teachers spend a lot of time with children once they enter school. Schools are also important social systems for children, and the classroom climate is important for children's mental well-being (Somersalo et al. 2002).

In accordance with our results, teachers have been considered most reliable informants concerning symptoms of attention problems and hyperactivity, and it has been recommended to include parent and teacher rating scales in ADHD assessment (Tripp et al. 2007). Some studies have also suggested that teachers are more prone to report a child's internalizing problems compared to parents (Loeber et al. 1990). In a previous report from this study cohort, the Rutter Teacher Questionnaire was found to have the best overall power to discriminate psychiatric disturbances compared to parent or child reports (Kresanov et al. 1998). Low agreement among parents, teachers, and children about the presence of childhood emotional

and behavioural problems or impairment in clinical and community settings is well documented in previous research (Achenbach et al. 1987, Jensen et al. 1999). Consequently, several informants are essential in order to obtain a reliable assessment of the child's global functioning and psychiatric state.

Importantly, the child's self-reported depressive symptoms, also when not reported by the parent or the teacher, predicted frequent drunkenness and daily smoking (**studies I, II, and IV**). Unique to the present study is the use of child self-report questionnaire at age eight. No prior longitudinal large-scale birth cohort studies have used the child him/herself as an informant in assessing depressive symptoms with a validated instrument (Haavisto et al. 2004). In previous studies, adults have reported fewer depressive symptoms in their children than have the children themselves (Angold et al. 1987, Puura et al. 1998). Asking about depressive symptoms directly from the child him/herself is important, as many depressive symptoms include highly subjective feelings and experiences, such as feelings of poor self-esteem, unhappiness, sadness and guilt. Puura et al. (1998) indicated in a previous report from this cohort that parents and teachers observe somewhat different aspects among children with a high level of depressive symptoms, and children report different things than adults see. On the other hand, adults may report more symptoms of conduct disorder than do the children themselves (Edelbrock et al. 1986).

As children get older, their reports of their mental health problems become increasingly important because many of the problems they experience remain unnoticed by parents and teachers (Sourander et al. 1999). Children of eight years or even younger have been shown to reliably report their internalizing problems (Luby et al. 2007). Kovacs (1986) has reported that eight-year-olds are able to consider their own affect separate from the environmental context, and to separate sadness from dysphoria. This birth cohort study is the first population-based study where depressive symptoms expressed by children themselves as precursors to later substance-use-related outcomes have been examined as early as at age eight. Furthermore, our findings emphasize the importance of active screening and reflective listening to the child's discomfort.



### 6.1.4 Correlates of substance-use-related outcomes in early adulthood

#### Key findings

- Frequent drunkenness associated independently with delinquent behaviour, smoking and illicit drug use, having friends, and a regular relationship.
- Internalizing problems, suicidal ideation, and poor friendship quality were more common among boys without drunkenness-related alcohol use compared to boys with occasional drunkenness.
- Illicit drug use without drug offending was not predicted by childhood psychiatric symptoms, but 22% of them had a psychiatric diagnosis in early adulthood. Drug offenders had psychiatric problems in both childhood and adulthood.
- The majority of young men with SUD diagnoses according to the Military Register had committed at least one crime, and half of them had at least five registered offences. The most common offence was property crime.
- Psychiatric comorbidity was high among those with substance-use-related crime. Drug offenders were psychiatrically more impaired than drunk drivers.

#### 6.1.4.1 Adaptive functioning and psychopathology

**In study V**, occasional drunkenness was shown to be associated with better adaptive functioning and less psychopathological deviance compared to those without drunkenness-related alcohol use or frequent drunkenness. Having friends and a regular relationship associated independently with drunkenness-related alcohol use, and these associations were most evident with frequent drunkenness. Poor friendship quality was found to be most common among boys who did not report drunkenness-related alcohol use. In addition, suicidal ideation, self-perceived severe mental health problems, and YASR internalizing problems, such as withdrawal, were more common among boys not reporting drunkenness, compared to boys with occasional drunkenness. This J-shaped curve of psychosocial well-being in relation to alcohol use has also been demonstrated in previous studies (Leifman et al. 1995, Pape and Hammer 1996). Also in accordance with our results, male abstainers in early adulthood have been shown to experience higher levels of distress, being less extroverted and less healthy (Caldwell et al. 2002).

In our study, having friends associated linearly with drunkenness frequency, while problems with friends were less common among boys with occasional drunkenness. This is in accordance with previous reports showing that socializing and high friendship quality associate with adolescent alcohol use (Urberg et al. 1997 Hoel et al. 2004). In addition to drunkenness, social competence has been found to associate with delinquency and initiation of dating at an earlier age (Griffin et al. 2006). In a study of Swedish conscripts, young men who reported high alcohol consumption, also reported more frequently that they never felt anxious or insecure (Andréasson et al. 1992). Leifman et al. (1995) have hypothesized that poor sociability could be a consequence of abstaining in early adulthood, when abstinence is uncommon. In our study, also childhood emotional problems predicted lower occurrence of drunkenness-related alcohol use (see, 6.1.2.3). According to our findings, it can be assumed that poor sociability is an antecedent rather than a consequence of abstaining from alcohol. Furthermore, particularly deviant peer relationships have been found to associate with substance use (Fergusson et al. 2002, Guo et al. 2002), while peers' prosocial activities have been found to associate with lower levels of substance use (Guo et al. 2002). Therefore, the nature and context of interpersonal relationships, rather than self-reported friendship quality may have an impact on substance use among young men. Furthermore, the association between drunkenness-related alcohol use and

social competence reflects the cultural acceptance of drunkenness as a drinking habit in Finland (Room and Mäkelä 2000, Mäkelä et al. 2006).

In this thesis, delinquency, smoking and illicit drug use associated independently with frequent drunkenness, further confirming prior research findings (Andréasson et al. 1992, Fergusson and Horwood 2000, Rimpelä et al. 2005, SAMSHA 2006, Swahn and Donovan 2006). Suicidal acts and self-perceived severe mental health problems were most common among this group. A high level of alcohol use and AUDs have been found to associate with suicidal behaviours (Pirkola et al. 1999). In our study, boys with frequent drunkenness also faced educational and occupational problems, a finding which has been established in various previous studies (see, e.g. Gfroerer et al. 1997, Ellickson et al. 2003).

**In study III**, 22% of boys with illicit drug use without drug offending had a psychiatric disorder according to the military register. APD and SUD were the most common psychiatric diagnoses, but also depressive and anxiety disorders associated with illicit drug use. It is well established, that psychiatric problems associate with illicit drug use (see, e.g. McGee et al. 2000, Stefanis et al. 2004, Wittchen et al. 2007). Drug use may cause depression, anxiety, and psychosis, independently of preceding psychopathology (Brook et al. 2002, Caspi et al. 2005, Hayatbakhsh et al. 2007, Moore et al. 2007, Henquet et al. 2006, Degenhardt et al. 2007, Wittchen et al. 2007). When interpreting these results it should be noticed that data on drug offences were registered at age 16-20 years, and early adulthood psychiatric diagnoses according to the military register at age 18-23. Thus, the causal associations between illicit drug use and psychopathology in early adulthood cannot be answered here.

#### 6.1.4.2 *Criminality*

**In study VI**, elevated levels of all crime types associated with SUD and APD according to the Military Register. SUD associated independently with property crime and drug offending after adjusting for other crime types and childhood parental education level. The strong link between SUD and offending was expected on the basis of previous reports (Fazel and Danesh 2002, Wallace et al. 1998). Furthermore, the overlap between SUD and APD is significant (Regier et al. 1990), and SUDs have been shown to independently predispose to crime (Fergusson and Horwood 2000). A substantial portion of crime, particularly violence, has been found to occur under the influence of alcohol or drugs (Martin 2001).

**In study VI**, psychiatric diagnoses among boys with substance-use-related offending, i.e. drug crime and drunk driving, were common, which is in accordance with previous research (Räsänen et al. 1999, Lapham et al. 2001, Belenko et al. 2003, Fergusson et al. 2003d, Feeney et al. 2005, Palmer et al. 2007). In this thesis, drug offending was found to associate more strongly with APD, SUD and psychotic disorder, while the association between specific psychiatric disorders and drunk driving disappeared after the childhood family background and involvement with other crime types were taken into account. However, the number of subjects with psychotic disorder was only 14, and therefore, the results should be interpreted with caution.

**In study III**, drug offenders had more psychiatric problems in childhood and in early adulthood compared to the boys with self-reported illicit drug use without drug offending. In many western countries, including Finland, citizens receive a criminal record even for the possession of a small amount of drugs for personal use. It has also been argued that a drug conviction may have a detrimental impact on people's lives but appears not to deter drug use among those so convicted (Lenton 2000, Wodak et al. 2002). Previously, cannabis-related offending has been found to associate strongly with cannabis dependency and problematic substance use compared

to those with self-reported use alone (Feeney et al. 2005, Fergusson et al. 2003d.) Also in line with our results, somatic concerns, anxiety, social dysfunction, and depression have been found to be prevalent among cannabis dependent offenders (Feeney et al. 2005). Fergusson et al. (2003d) have also reported that cannabis offending associates with recidivist crime, being an element of an antisocial lifestyle in general.

Accordingly, young offenders, particularly those with recidivist, drug and property crime, are in need of psychiatric and substance use assessment, and access to care should be easily available. Furthermore, the accumulation of substance use, crime and mental health problems highlights the complex treatment needs among this subgroup of young men.

### 6.1.5 Help-seeking

#### Key findings

- Help-seeking for mental problems was more common among boys with frequent drunkenness.
- Entering substance use treatment was non-existent at age 18.

**In study V**, help-seeking was more common among those with frequent drunkenness, and one third of the mental health service users reported frequent drunkenness. However, the majority of the help-seekers with frequent drunkenness had had contact only with general mental health services. Only five boys, accounting for 10% of all mental health service users, had had contact with specialized services for substance use treatment. Unfortunately, this study did not include information on how alcohol-use-related problems were managed at the mental health services.

Our results are in line with previous studies reporting that the rate of receiving substance use treatment among adolescents is very low (Wu et al. 2002, McLellan and Meyers 2004). Globally, alcohol abuse and dependence have been estimated to have the widest treatment gap of all mental health problems (Kohn et al. 2004). There are numerous studies documenting the failure of primary care settings to identify and differentiate young people who use, abuse, or are dependent on substances (McLellan and Meyers 2004, Keränen et al. 2001). For instance, a study from the United States indicated that the topic of substance abuse was rarely initiated by physicians encountering adolescents during office visits (Klein et al. 1999).

Also previous Finnish studies have shown that substance use is common among adolescents entering mental health service use (Karlsson et al. 2006). In a previous report from the present study cohort, only 10% of those within the clinical range on the YASR Total Problem Scale had been in contact with services, indicating that the treatment gap also exists in the psychiatric services (Sourander et al. 2004). When Finnish adolescent psychiatric treatment services were evaluated, multiple problems were detected, including unclear differentiation between primary and secondary care, and poor functioning of the chains of treatment for adolescents (Laukkanen et al. 2003). In addition, a limited capacity of primary care in the early detection of mental disorders was observed (Laukkanen et al. 2003). Furthermore, substance use problems have been found to be overlooked among adolescents entering specialized services, i.e. the mental health system, but also the juvenile justice, and child welfare systems (Aarons et al. 2001). Most likely, the late-adolescent boys with frequent drunkenness are not offered any interventions to reduce their alcohol use, not even when entering mental health service use.

In spite of the high psychiatric comorbidity among the young people entering substance abuse treatment (Dennis et al. 2004), receiving mental health treatment within the substance use

services is rare (Jaycox et al. 2003). This is also evident amongst judiciary. Belenko et al. (2003) have indicated that more than two thirds of drug offenders in estimated need of psychiatric treatment had never received any psychiatric treatment. Additionally, it is obvious that patients with co-occurring substance use and psychiatric disorders are found in both substance use and mental health service systems (Havassy et al. 2004). Therefore, treatment providers, independent of the treatment system, should provide interventions equally for both mental health and substance use problems.

In Finland, Pirskanen et al. (2007) have proposed screening and an early intervention model provided by school health nursing for adolescent at risk of substance-use-related harm. However, although screening and brief interventions, such as treatment models including cognitive-behavioural therapy, motivational interviewing, and family therapy approaches, are most likely efficacious, the efficacy of a range of treatment approaches has not yet been reliably established (Toumbourou et al. 2007). Furthermore, although universal strategies to reduce the attractiveness of substance use have shown promising results (Toumbourou et al. 2007), there are no firm results on the effectiveness of universal primary prevention interventions concerning alcohol misuse among young people (Foxcroft et al. 2003, Foxcroft. 2006). When planning interventions, also the effects of the prevention paradox should be taken into account. The paradox arises because although heavy drinkers are at the highest risk of alcohol problems, most problems still accrue to the lesser-drinking majority of the population simply because the latter group is much larger (Poikolainen et al. 2007). Most probably, the preventive strategies aimed at the majority of the population should focus on heavy-drinking occasions rather than on mean consumption (Gmel et al. 2001). To date, delivering services to young people who are likely to have substance-use-related problems remains a central public health challenge.

## 6.2 Methodological considerations

### Strengths

- Nationwide study population including 10% of births in 1981 in Finland.
- Longitudinal design from childhood to early adulthood with low attrition.
- Valid measures and use of multiple informants at baseline at age eight.
- Use of multiple information sources at follow-up (self-reports and nationwide registers).

### Limitations

- Limited information about childhood family and other environmental factors.
- Lack of child psychiatric diagnoses and use of structural diagnostic interviews at baseline and at follow-up.
- Only boys were included.

The major strengths are the longitudinal **study design** from childhood to early adulthood and the unique nationwide study population including 10% of births in 1981 in Finland. The well-conducted baseline data collection covered 97% of the selected study population. Attrition at the 10-year follow-up at age 18 was 20% (24% of the original target population). In prior longitudinal birth cohort studies, the attrition rate at early adulthood follow-up has varied from 4% to 56%, and the number of study participants in most studies has been significantly lower (see **Table 2**). The **drop-out group** (not attending the survey at military call-up) had a significantly higher level of psychopathological features, and they were less likely to be living with both biological parents at age eight, which may have had an effect on the results (Haavisto et al. 2004).

Among the **subjects**, the present study did not include females, so the results may not apply to both genders. However, the follow-up data of the present study cohort are so far the largest male sample worldwide providing prospective data on childhood psychiatric symptoms. The large study sample gives reasonable statistical power for primary analyses, controlling for confounding factors, and use of multiple-class variables when assessing the level of self-reported substance use in statistical analyses.

The **methods used at baseline** have been widely used in child and adolescent psychiatric epidemiology, and they have been shown to be valid and reliable (Achenbach 1997, Kresanov et al. 1998). The lack of child psychiatric diagnoses can be considered as a limitation in the present study, as structural diagnostic interviews have been regarded as a golden standard in psychiatric epidemiology (Costello et al. 2005). However, it has been stated that there is no single best way to identify psychiatric disorders using face-to-face psychiatric interviews (Costello et al. 2005). Parallel to this clinical viewpoint is a *psychometric perspective*: how to conceptualize psychiatric disorders (Hartman et al. 2001). The dimensional system acknowledges that there may be clinically important individual differences among those who fall above, and those who fall below, a categorical diagnostic threshold (Helzer et al. 2006). Such differences between individuals might include elements such as the number or pattern of positive symptoms, the severity of symptoms, or co-morbidity (Helzer et al. 2006). “Empirical syndromes” are commonly used in questionnaires. These syndromes are empirically generated on the basis of statistical covariation between symptoms without a priori conceptions of what the important constituents of the taxonomy should be (Hartman et al. 2001). Furthermore, previous investigations have shown the validity of the dimensionally scored variables for externalizing disorders. They have also been shown to be better predictors of outcome than measures based on a diagnostic classification, as dichotomizing the symptom distribution using diagnostic criteria misses information about the dose-response functioning and symptom distribution (Fergusson and Horwood 1995).

One of the weaknesses of the present study is the limited information about **childhood family and other environmental factors**. In addition to familial substance use, the present study also lacks information about parental psychopathology, parenting style, and family environment, all of which may significantly contribute to the offspring’s substance use. Furthermore, no specific information about childhood peer relations was available.

In terms of **outcome variables**, the following caveats in **assessing substance use** should be taken into account when interpreting the result of the present studies: (1) all information about substance use was based on a self-report questionnaire. Subjects may tend to underestimate their substance use, particularly of illicit drugs when used occasionally (Allen and Wilson 2003). Furthermore, reliability levels for self-reported drug use have been considered to be situational (Brenner et al. 2003). (2) Only information about frequency of drunkenness, cigarette smoking and illicit drug use was collected. The study lacks information about the quantity of alcohol consumed, use of smokeless tobacco, inhalants and specific illicit drugs. (3) The questionnaire in 1999 did not include any information about substance-use-related problems e.g. alcohol or drug overdoses, as well as accidents, suicidal acts, and antisocial behaviour while intoxicated. (4) The degree of substance use severity, problematic use or dependency was not assessed using a structured diagnostic interview. However, it has been argued that adolescent substance use should not be studied alone using categorized SUD diagnoses, as this approach may miss information about substance use behaviours in the beginning of their substance use career (Harrison et al. 1998, Martin et al. 1995, Martin and Winters 1998). When assessing substance use behaviours, frequency of drunkenness has been suggested to be the single best indicator of problem drinking among young adults (Bailey 1999). When studying cigarette-smoking frequency, smoking more than 10 cigarettes has been found to strongly associate with nicotine

dependence, particularly among adolescents (Kandel and Chen 2000). (5) No information about age of initiation of substance use was collected. (6) Lastly, information about substance use of parents and peers was not available.

The **use of register data** enabled the study of outcomes even for subjects who did not attend the survey in 1999. Only a few longitudinal population-based studies have included a wide range of outcomes, or have examined reports across different information sources, for example, crime register data, clinical evaluations, and self-reports (Fergusson et al. 2005a). Access to nationwide registers for research purposes is distinctive to Nordic countries. In many countries, valid national registers are not available, and if they are, their use is restricted by data protection laws.

**The Military Register** includes comprehensive and unique information from the total age cohort, and also those young men are reached who have not been in contact with the health care sector. However, the ICD-10 diagnoses according to the Military Register were unstandardized and potentially subject to validity problems. In addition to SUDs, underrecognition and undertreatment of depression and anxiety disorders is a well-identified problem among both adolescent and adult populations (Haarasilta et al. 2003, Honkonen et al. 2007), and it is likely that these disorders are underrepresented in the Military Register as well.

**The National Police Register** gives comprehensive and unique information about criminal offences. Most of the previous studies on criminality have mainly focused on serious crime such as violent crime or crime in general, ignoring other crime categories, such as substance-use-related crime and property crime. Corruption in Finland is among the lowest in the world (Transparency International. 2007) and the importance of accurate registering of every offence is emphasized in the instructions given by the Police Administration. Offending data were preferred to court data that only include convicted offenders and ignore a huge amount of crime. As a limitation, information about crime was based on authority reports alone, and no self-reported data about crime were available. Hidden criminality refers to the fact that not all criminal behaviour comes to the notice of the police. For instance, drug offending lacks an outsider victim, and the number of drug offences in the police register is associated solely with the authority activity and drug control policy of the authorities. On the other hand, studies based on victim surveys and self-reports of offending are biased by forgetting and distortion, and by a reluctance to report incidents. Furthermore, the police may not always book every single (minor) offence. When comparing the present results with information from other countries, it is important to notice that in Finland, using and possession of narcotics is always a criminal offence. In the present study, not specifying the intoxicating drugs used while driving can be considered a limitation. Here, the term drunk driving has been used to describe driving under the influence of any intoxicating substance, which may include also those offences when a subject has been intoxicated by, e.g. illicit drugs or prescription drugs of abuse. However, in 1996, alcohol use was detected in 99% of the Finnish drunk drivers; drug use alone was detected in only 0.4% of the cases, and in combination with alcohol in 22% of the cases (Christophersen et al. 1999).

## 7 CONCLUSIONS

The findings of this thesis show that substance use accumulates in boys with psychiatric problems both in childhood and in early adulthood. Particularly boys with conduct, hyperactive and comorbid conduct-emotional problems have elevated rates of substance-use-related outcomes in early adulthood. In addition, childhood self-reported depressive symptoms are a risk factor for subsequent substance use, particularly for daily smoking.

Accordingly, a policy of routine screening for childhood psychiatric symptoms in the school health care system should be implemented nationwide. The use of validated questionnaires in schools is a cost-effective way to identify the high-risk children for later substance-use-related problems and other risk behaviours, such as crime. When assessing childhood psychopathology, collecting information from parents, teachers, and children themselves, is highlighted. Teacher's evaluation of a child's problems behaviour was shown to have the best predictive power for subsequent substance use. Accordingly, it is recommendable to include teacher evaluations of child psychopathology in routine assessment in the school health care system. Importantly, also child's self-reports of depressive symptoms, also when not detected by parent or teacher, are an important source of information. To reach boys at risk of substance-use-related problems, collaboration between teachers, school health care and families is of the utmost importance, and stigmatisation of psychiatric problems should be avoided. However, the screening approach requires second-stage clinical evaluations and effectively functioning child mental health services. Otherwise, mass screening of children's psychiatric problems is unethical (Mant and Fowler 1990).

Prevention efforts should begin already in childhood and take into account both psychiatric symptoms and environmental factors that predict subsequent substance use. From a clinical standpoint, our results emphasize the management of childhood ADHD symptoms, conduct problems and comorbid conduct-emotional problems. Targeted early interventions, such as parent training programs (Petrie et al. 2007) and universal school-based interventions to reduce conduct problems (Furr-Holden et al. 2004, Poduska et al. 2008), have shown promising results in reducing later substance-use-related harm. As hyperactive problems associated with every substance-use-related outcome, the treatment needs of boys with hyperactive and attention problems should always be more closely assessed. In addition, the parental needs for support and treatment should be recognized, and efforts should be made to assist families in obtaining help.

In late adolescence and early adulthood, efforts should be made to integrate the substance-use-treatment perspective with other services where young men are encountered. Ideally, substance-use-related problems should be addressed in various health service components. The primary stage to identify substance-use-related problems could be located in school health care systems, where the majority of the youths can be reached. There, on-site brief interventions designed to prevent escalation of use into abuse or dependence could be provided for adolescents who have mild or moderate severity of problems. Furthermore, efforts to increase access to assessment and continuing care should be made where young men are encountered, e.g. health clinics and mental health services, social service agencies, and the judiciary. The obligatory military call-up procedure also offers an excellent possibility to reach young men with substance-use-related problems. Psychiatric problems and risky behaviours, such as delinquency should always be assessed along with substance use. Specialized and multidisciplinary care are

required for young men who have multiple or complex needs, for instance, for young men with drunk driving, drug offending and recidivist crime.

However, the high social acceptability of alcohol use makes prevention and offering early interventions in late adolescence intricate. Additionally, not all substance use associates with adversities. In late adolescence, curbing alcohol misuse and influencing attitudes towards drunkenness-related alcohol use within youth culture may be more attainable goals than preventing any alcohol use.

Targeted early interventions are highlighted, but a challenge for developmental psychiatry is that of devising effective interventions and treatments for psychiatric problems early in life. We still do not know what regimens are cost-effective to prevent, not only substance-use-related harm, but also other risky behaviours, such as crime. Additionally, what is the best timeframe for these interventions? Future research should address the question whether the effects of early stage interventions are long-lasting enough to reduce adverse outcomes of adolescent and adult health, including substance-use-related problems and their burden on public health.



## 8 ACKNOWLEDGEMENTS

This work was carried out in the Department of Child Psychiatry at the University of Turku during the years 2004-2008. This thesis is part of the “From a Boy to a Man“ follow-up study included in the Epidemiological Multicenter Child Psychiatric Study in Finland.

I am most indebted to Adjunct Professor André Sourander for his abundant support, encouragement, and friendship. During my PhD process I have constantly been inspired by his creativity, enthusiasm for doing research and always seeing the sunnier side. I was fortunate to have Research Director, Adjunct Professor Kari Poikolainen from the Finnish Foundation for Alcohol Studies as my second supervisor. I have been privileged to benefit from his comprehensive expertise in epidemiological research in the field of substance use studies.

I wish to thank the official referees of this thesis, Professor Eila Laukkanen and Professor Tytti Solantaus for their constructive feedback.

I am grateful to Professor Jorma Piha for his support and the opportunity to carry out my thesis studies in the Department of Child Psychiatry. Additionally, I wish to express my gratitude to Professor Fredrik Almqvist from the University of Helsinki; Professor Kirsti Kumpulainen from the University of Kuopio; Professor Irma Moilanen, from the University of Oulu, and Professor Tuula Tamminen from the University of Tampere. In addition to co-authoring, all their efforts in setting up this study cohort in the 1980's have been irreplaceable. I also wish to express my warmest thanks to all those researchers not mentioned above who have participated in collecting the baseline data. I hope that my gratitude also reaches the families and teachers and those participating in the study in 1989.

I wish to express my gratitude to Hans Helenius, MSc, for sharing his immense knowledge of biostatistics and epidemiological research. I also want to thank Lauri Sillanmäki, MSc, and Georgios Nikolakaras, MD, for their assistance and careful work with our data.

I warmly thank Naval Commander Kai Parkkola, MD, PhD, for organizing the data collection at the Finnish Defence Forces in 1999, as well as for his co-authorship. I am most grateful to my fellow-researchers Henrik Elonheimo, LL.M, Petteri Multimäki, MD for co-authoring. Also Terja Ristkari RN, MNSc, and Antti Haavisto, MD, are thanked for all their efforts in the “From a Boy to a Man” study.

I sincerely thank my co-authors from Columbia University, New York City, USA: Professor Ezra Susser, Assistant Professor Daniel J Pilowsky and Assistant Professor Ping Wu. Their guidance and valuable advice have been most helpful.

Professor Raimo KR Salokangas is warmly acknowledged for sharing his thoughts in the very beginning when I was still considering whether I should do research or not.

I would like to acknowledge Jaqueline Välimäki MA for revising the English language of the original articles and my thesis manuscript.

## Acknowledgements

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Many of my friends have played a decisive role in my PhD process during these years: the members of the VAPA Association, i.e. Linnea Karlsson, Salla Koponen, Outi Laine, Sinikka Luutonen, Tanja Martin, Teija Nummelin, Jaana Pirttialo, and Raili Svartsjö. In addition to discussions, scientific presentations, and wonderful dinners, our self-help group for female psychiatrists has provided me with continuous support. In particular, I want to thank Salla for stimulating exchange of ideas, no matter what the subject or how bizarre in nature.

It has also been a great pleasure to network with researchers in the field of child psychiatry, namely, Leena Pihlakoski, MD, Päivi Santalahti, MD, PhD, and Florence Schmitt, MA.

I want to acknowledge my dear friends from my old hometown Oulu, for all their support, prior to and during the PhD process. With equal complacency, I want to thank my friends in my current hometown Turku for convincing me that one can actually have a happy life in these parts of the country as well. Thank you all for reminding me that there is (maybe) life beyond science. I want to share a collective “junttaus” with all of you, what more could there be to say?

My dear parents, Lea and Pentti Niemelä have given me not only their constant support while reaching my academic goals, but also the joy of never-ending learning, for which I am most grateful. I want to thank my brother Karri Niemelä, my sister-in-law Sari Kalliskota, and their children Sampo and Siiri, my brother Tuomas Niemelä and his companion in life, Sanna Heikkinen, for being an important source of enjoyment and for giving me a solid feeling of togetherness. I also want to thank Karri for sharing his experiences in the field of science. My mother-in-law Anja Saario is warmly thanked for all her kindness and support.

The deepest gratitude I owe to my spouse, Hanna Saario. I have been able to capitalize on her expertise in information-seeking, which has been most helpful while completing this work. Additionally, I want to acknowledge her patience, understanding, erudition, and excellent cookery skills as examples of her numerous virtues. I feel that I have been more than lucky in my life to have her by my side.

This work was supported by grants from The Finnish Culture Foundation, The Finnish Medical Foundation, the Finnish Foundation for Alcohol Studies, the Yrjö Jahnsson Foundation, the Jalmari and Rauha Ahokas Foundation, The Turku University Foundation, The Lastentautien kummissäätiö, The Sigrid Juselius Foundation, the Orion Research Foundation, and EVO grants from Turku University Hospital and Turku City Hospital.

Turku, May 2008



Solja Niemelä

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