

# **Psychological factors associated with substance use in adolescents**

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# DOCTORAL DISSERTATION IN PSYCHOLOGY

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## Abstract

Gunnarsson, M. (2012). Psychological factors associated with substance use in adolescents. Department of Psychology, the University of Gothenburg, Sweden.

This thesis examines possible factors related to use of substances, with specific focus on psychological factors associated with increased risk of using illicit drugs. Thus, factors such as gender, personality traits, mental health status as well as family settings were investigated. Other factors also studied were use of tobacco, alcohol and illicit drugs, age of debut for substance use, subjective response to illicit drug use, attitudes towards drug use and future intentions of illicit drug use. An additional aim was to validate the health relevant personality inventory (HP5i) for adolescents. Participants were 3419 male and female senior high school students (18 years) in a cross-sectional study. Respondents filled out a self-administered questionnaire and the study was carried out in the participants' schools. *Study 1* showed that HP5i is a valid inventory and traits found to be associated with risk consumption of substances were mainly antagonism and impulsivity. Results from *Study 2* showed that additional factors, such as problems within the rearing family, individual mental health problems and regular and excessive intake of legal substances, was associated with illicit drug use. Furthermore, significant associations between excessive use of illicit drugs, positive drug effects as well as intention of future drug use were found. In *Study 3* groups of adolescents with different psychological profiles, based upon levels of impulsivity, depressive symptoms and positive drug effect were identified. Individuals characterised by high levels of the clustering variables reported severe use of substances and occurrence of other well known risk factors associated with substance use. Similar cluster profiles were also identified in a sample of adolescent in treatment for substance abuse. The findings from this thesis emphasize the fact that several psychological factors are associated with substance use in adolescence. Notable, the variable "positive drug effect" seems to be highly related to excessive illicit drug use and to intention of future drug use. Enhanced knowledge about factors related to substance use is important for the development of effective preventive and treatment strategies concerning adolescents' substance use.

*Key words:* Adolescent, Tobacco, Alcohol, Illicit drugs, Mental health, Personality, Risk factors, Substance use,

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# PREFACE

This thesis is based on the following three studies:

1. Gunnarsson, M., Gustavsson, J. P., Tengström, A., Franck, J. & Fahlke, C. (2008). Personality traits and their associations with substance use among adolescents. *Personality and Individual Differences*, 45, 356-360.
2. Gunnarsson, M., Tengström, A., Gustavsson, J. P., Franck, J. & Fahlke C. (2012). Adolescents illicit drug use: relationships to subjective response and intention of future use. *Submitted*.
3. Gunnarsson, M., Gustavsson, J. P., Rudman, A., Tengström, A., Franck, J. & Fahlke C. (2012). Psychological profiles of adolescents using illicit drugs. *Submitted*.

## **TACK !**

Jag vill först och främst framföra ett stort tack till min handledare, professor Claudia Fahlke. Hon har med sin outtröttliga entusiasm och energi, sin positiva inställning, imponerande generositet och prestigelöshet samt förstås sin stora kunskap stöttat arbetet och bidragit stort till att göra detta möjligt. Stort tack också till mina två bihandledare, professor Johan Franck och docent Anders Tengström, samt till professor Petter Gustavsson, för att så generöst bidragit med kunskaper och kloka synpunkter.

# POPULÄRVETENSKAPLIG SAMMANFATTNING

Ungdomsåren är en tid av förändring och ofta den mest omvälvande tiden i en persons liv. Det är också den period i livet som människor i allmänhet är mest riskbenägna och nyfikna på att prova nya saker, som till exempel att testa droger. Men varför vissa personer använder droger och andra inte är en mångfacetterad fråga och inte helt klarlagd. Ofta förklarar forskningen beteendet med individuella faktorer, egenskaper i den sociala miljön och det komplexa samspelet mellan individ och miljö.

Syftet med avhandlingen var därför att undersöka individuella faktorer som är relaterade till ungdomars användning av tobak, alkohol och narkotika.

Inriktningen ligger särskilt på psykologiska faktorer förknippade med ökad risk att använda narkotika under ungdomsåren. Inom ramen för avhandlingen validerades även personlighetsinstrumentet *Health relevant Personality inventory* (HP5i).

I en tvärsnittsstudie studerades 3 419 gymnasieelever från Västra Götalands län. Fördelningen mellan pojkar och flickor var jämn och medianåldern var 18 år. Respondenternas besvarade en enkät med frågor om drogvanor och psykisk hälsa och undersökningen genomfördes i deras respektive skolor. Faktorer som undersökts var bland annat personlighet, psykisk hälsa, användning av droger (tobak, alkohol och narkotika), subjektiva narkotikaupplevelser, intentioner till framtida droganvändning samt psykiska och/eller drogrelaterade problem i den biologiska familjen.

Avhandlingen består av tre studier. Resultatet från *Studie 1* visar att HP5i är ett användbart personlighetsinstrument vid bedömningen av personlighetsdrag hos

ungdomar. Eftersom instrumentet är mindre omfattande passar det bra för populationsundersökningar eller i andra sammanhang där ett längre och mer omfattande och tidskrävande instrument inte är lämpligt. Resultatet från *Studie 1* visar också att flertalet av de fem undersökta egenskaperna var relaterade till riskkonsumtion av substanser hos ungdomarna. Framförallt visade antagonism och impulsivitet på signifikanta kopplingar till riskkonsumtion av droger.

Resultatet från *Studie 2* visar att de flesta av de övriga psykologiska faktorer som undersöktes också är associerade till droganvändning under ungdomsåren. Psykisk ohälsa, som till exempel depressiva symptom, frekvent användning av tobak och alkohol, psykiska och/eller drogrelaterade problem i den biologiska familjen var alla faktorer relaterade till användning av narkotika. När det kommer till ungdomar som använder narkotika visar resultatet från *Studie 2* att positiva psykologiska upplevelser av droganvändningen ökar sannolikheten för att personen ska ha intentionen att fortsätta använda narkotika. Detta gäller framförallt för de ungdomar som har använt narkotika vid ett fåtal tillfällen. Graden av positiva psykologiska upplevelser av droganvändningen var också en av de variabler som var starkast förknippad med en mer omfattande konsumtion av narkotika. Själva drogupplevelsen i sig verkar alltså vara av stor betydelse för hur mycket droger som används och för intentionen att fortsätta använda narkotika. Detta gäller även när betydelsen av andra kända så kallade riskfaktorer för droganvändning analyseras.

I studie *Studie 3* grupperades ungdomarna i kluster utifrån deras rapporterade nivåer på variablerna impulsivitet, depressiva symptom och positiva drogupplevelser. Nio kluster identifierades och validerades i en annan population av ungdomar. Dessa kluster analyserades sedan med avseende på ett antal faktorer som tidigare forskning visat vara riskfaktorer för narkotikaanvändning hos ungdomar. Utifrån analyserna kunde kluster

kategoriseras som möjliga högrisk- eller lågriskgrupper. De ungdomar som rapporterade höga nivåer av samtliga klustreringsvariabler (impulsivitet, depression och positiva drogupplevelser) visar på förekomsten av flera välkända riskfaktorer samtidigt, till exempel hög konsumtion av olika droger, tidig drogdebut, avvikande personlighetsdrag, psykiska problem, intentioner till framtida användning och en ärftlig sårbarhet. Men resultaten från *Studie 3* visar också att enbart höga nivåer av en av de tre klustervariablerna var förknippad med ett flertal andra kända riskfaktorer. Ungdomar med dessa profiler kan därför tänkas löpa större risk att utveckla missbruk och beroende i framtiden. I *Studie 3* framkom positiv drogupplevelse som en av variablerna som var starkast förknippad med hög konsumtion av narkotika. Medvetenheten om de positiva effekterna som narkotika kan ge dem kan vara en riskfaktor i sig, speciellt när många står inför en ovisshet och ibland osäkerhet inför övergången till vuxenlivet. Det bör också noteras att många ungdomar som provar narkotika även upplever negativa psykologiska effekter av narkotikaanvändning och att majoriteten av dem inte söker hjälp för problem som har med dessa att göra. Därför är det viktigt att personal som möter ungdomar i sitt arbete också är medvetna om att symptom på psykisk ohälsa kan vara narkotikarelaterade.

Resultaten från denna avhandling visar att flera psykologiska faktorer förknippas med droganvändning i ungdomsåren. Samspelet mellan dessa faktorer och eventuell drogkonsumtion är komplext och mångfacetterat. Fördjupad kunskap om riskfaktorer som är relaterade till droganvändning är viktigt för utvecklingen av effektivt förebyggande arbete och behandlingsstrategier.



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# INTRODUCTION

The term adolescent originates from the Latin verb *adolescere*, meaning “to grow”. Adolescence is a period of change and often the most transformative stage in an individual’s life. Previously, the adolescent ages were equivalent with the teen ages but due to cultural and socioeconomic changes in the past century the adolescent span has been considerably lengthened. The period is more often said to extend from around 10 years of age to some years over 20. The definition is, however, still largely dependent on culture and context (Steinberg, 2002).

During the adolescent period of transition individuals are generally more prone to be involved in different types of risk behaviour, such as unsafe sex and substance use. Why some individuals use substances and others not, is a multifaceted issue not fully understood. However, different explanations have been proposed, often dealing with individual characteristics and risk factors in the social environment, and the complex interaction between them. This thesis examines possible factors related to use of substances<sup>1</sup>, with specific focus on psychological factors associated with increased risk of using illicit drugs. When studying different factors associated with adolescents’ substance use, it is important to also take into account the normative psychological development during the adolescent years in order to get a broader understanding of the problem (e.g. Brown et al., 2008; Casey & Jones, 2010; Steinberg, 2008). Therefore, before introducing the research field on risk factors related to substance use in adolescents, the introduction of this thesis starts with a brief orientation of the psychological development of adolescence.

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<sup>1</sup> The term substance includes tobacco, alcohol and illicit drugs if nothing else is stated.

## **Psychological development of adolescence**

The psychological development, which occurs during the adolescent period of life, can be expressed based upon the interplay between a set of three basic and universal changes, and the context in which these changes are experienced. These three sets of changes are biological, cognitive and social transition (Steinberg, 2002).

### **Biological transition**

During adolescence, physical changes in specific areas of the maturing brain result in individual cognitive and behavioural changes (Casey, Getz & Galvan, 2008). Brain imaging techniques, such as functional magnetic resonance imaging and positron emission tomography, have made it possible to observe such changes (Lenroot & Giedd, 2006). Several aspects of brain maturation can thus be linked to behavioural, emotional and cognitive development during adolescence (Spear, 2000; Casey, Tottenham, Liston, & Durston, 2005). For example, certain parts of the brain (e.g. prefrontal cortex) are remodelled during these years, resulting in more effective and focused social information processing (Adolphs, 2003). The development of the prefrontal cortex area, involved in higher cognitive functions such as planning, decision making and empathy, is however not completed until the end of adolescence or the beginning of early adulthood (Casey, Galvan & Hare, 2005). During adolescence there are also changes in the activity of central neurotransmitters, e.g. serotonin and dopamine, which are important for mental well-being (Crews, He & Hodge, 2007). Altered activity of central neurotransmitters can make individuals more prone to become involved in risky activities such as substance

use (Rao & Chen, 2008; Steinberg, 2008). These changes can also increase the risk of developing mental health problems during adolescence, such as depressive symptoms and anxiety (Davey, Yucel & Allen, 2008). Throughout the period, the endocrine systems also become more active which can affect the adolescent's behaviour, for example, becoming more prone to risky activities such as substance use (Crews et al., 2007).

## Cognitive transition

Mental abilities, such as problem solving and reasoning abilities, continue to develop during adolescence. These improvements are supported by development of specific core cognitive processes which are still immature in late childhood, for example, processing speed, voluntary response processing and working memory (Luna, Garver, Urban, Lazar, & Sweeney, 2004). These changes in cognitive functioning are of great importance for how the growing individual can interact with the environment and develop towards independence (Steinberg, 2008). For example, the adolescent gets better at understanding the logical consequences following a specific act or a specific behaviour. The maturing individual also becomes more skilled at understanding abstract matters and abstract reasoning. Furthermore, adolescents develop their meta-cognitive reasoning, e.g. thinking of the thinking process itself (Steinberg, 2005). During adolescence, young people also develop more effective multidimensionality, i.e. being able to focus on more than just one single issue. Moreover, they are more likely to question others' assertions and are less likely to accept facts as absolute truths (Steinberg, 2005).

## Social transition

Social transition involves the process of social redefinition when young individuals separate from their parents and orient themselves towards adulthood (Steinberg, 2008). During this process of social transition, interaction and affiliation with peers is assumed to play a particularly important role for the individual. Peer interaction can help the adolescent develop social skills separate to those learned from the family and home environment, and thereby advance a more efficient transition towards independence from the family (Spears, 2000). Hence, peer influence can be constructive, resulting in increased self-confidence and autonomy. It can, however, also be destructive, promoting for example deviant behaviour such as excessive alcohol consumption and use of illicit drugs (Spooner, 1999; Steinberg 2005). Along with this change in social orientation from family to peers, adolescence is also frequently characterized by an increase in the perceived number of conflicts between the adolescent and their parents (Spears, 2000). The social transition is to a high degree culturally and contextually dependent (Steinberg, 2002).

## Context

The context in which biological, cognitive and social transitions takes place is related to influences from the individual's environment such as the family, peers, school, work or leisure time. In the field of behavioural genetics such influences are often divided in three types; genetic influences, shared environmental influences and non-shared/unique environmental influences. The genetic influence is referred to as the individual's biological and genetic heritage which is not dependent on the context. Shared environmental influences are for example common factors among siblings in a family, e.g. parents or other

siblings, while non-shared environment is the unique environment an adolescent facing outside the family e.g. peers and school environment (e.g. Kendler, Jacobson, Prescott & Neale, 2003).

During adolescence, the individual is generally more often involved in risky activities, such as unsafe sex and substance use, than in other parts of life (Casey et al., 2008). Involvement in risky activities seems to increase with the transition from child to adolescent, peak in mid/late adolescence and thereafter decrease during the transition from adolescence to young adulthood (Rao & Chen, 2008). Increased risk proneness, as one characteristic of the adolescent period, can thus be considered to be a part of normal development when transitioning into adulthood (Steinberg, 2008). However, there are considerable individual differences in risks taking and factors associated with substance use need to be set in relation to the individual development and age related transitions (Galavan, Hare, Voss, Glover & Casey, 2007). Occurrence of risk periods for substance use is usually during major transition in a person's life. First, when children enter school and their response and adaption to this new situation can affect later developmental progress. Later when they advance from elementary school they often experience new academic and social situations, for example meet a wider group of peers. It is at this stage in early adolescence that children are most likely to encounter substances for the first time. Then, again, when entering high school, adolescents will face additional social and individual challenges. At the same time they may be exposed to greater availability of legal and illegal substances. When adolescents/young adults leave home for university or work the risk of abusing substances is at its highest for some individuals – depending on their current situation in combination with their previous developmental trajectories (e.g. Brown et al., 2008).

## **Adolescents and substance use**

During the normative development of adolescents there are several periods where adolescents are vulnerable and at high risk of initiating substance use. It should, however, be pointed out that there is a great variation in patterns of substance use at an individual level. On the other hand, when taking a population based perspective of the phenomenon, normative patterns of adolescent substance use are revealed. These patterns are, from an epidemiologic viewpoint consistent and predictable. Prevalence of substance use increases rapidly from early to late adolescence, peaks during the transition to young adulthood, and declines through the remainder of adulthood (Griffin & Botvin, 2010). This section presents a brief overview of substance use among adolescents, with focus on illicit drug use, and the potential adverse health effects of substance use. The section ends with a short presentation of some significant psychological theories regarding substance use.

### **Prevalence of substance use**

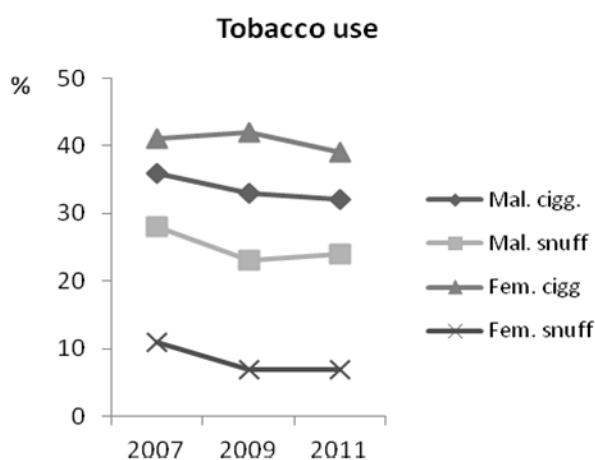
There are several ways of estimating the prevalence of substance use. The most common ways are the so called direct methods, such as population surveys and school surveys, or by using different biological markers for detecting use of substances (e.g. urine or blood sample). Another also commonly used method, although more indirectly, is for example estimating the prevalence on the basis of numbers of adolescents who are or have been in treatment for substance use related problems. There is always a certain level of uncertainty when calculating the frequency of substance use in a population, no matter which method is used. For example, results from school surveys are affected by social desirability and

other biases. Other sources of incorrect results are systematic missing data due to that different groups are not present at school when conducting the survey. Furthermore, research has shown that results from school surveys often indicate lower level of prevalence than actual level, especially regarding illicit drug use (e.g. Macleod, Hickman & Smith, 2005; Palmer et al., 2009).

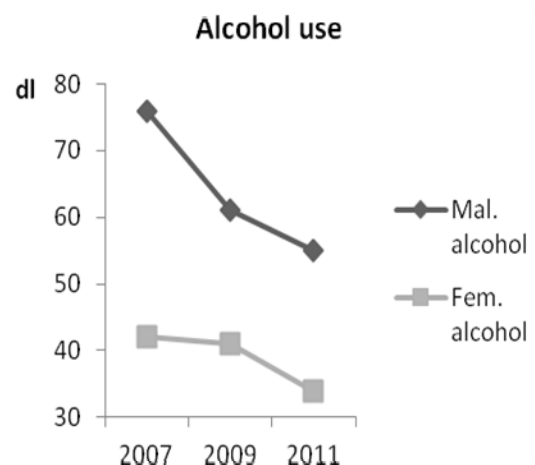
Since studies from different countries often use various methods for estimating the prevalence of substance use, comparison of results between countries could be misleading. The interpretations of reported estimates should therefore be made with awareness of these methodological limitations (Degenharth & Hall, 2012). However, using the same method of measurement for several years within the same country offers relatively high reliability and opens the possibility of detecting trends in substance use among adolescents (Henriksson & Leifman, 2011). This procedure is, for example used by the *European School survey Project on Alcohol and other Drugs* (ESPAD), which is a collaborative effort of independent research teams in more than forty European countries and the largest cross-national research project on adolescent substance use in the world. Data from the latest ESPAD survey, conducted in 2007, report substance use trends in 20 European countries for adolescents at an age of 16 years (ESPAD, 2007). From 1995 to 2007 the consumption of tobacco, alcohol and illicit drug use, was on an average, rising for the first ten years (1995-2005), but has since then decreased or at least stabilized. According to the *European Monitoring Centre for Drugs and Drug Addiction* (EMCDDA) annual report 2011 (EMCDDA, 2011), the prevalence of illicit drug use in Europe is historically high, but data from national studies conducted in 2008 and 2009 indicate that prevalence has not increased further.



In Sweden, data from *the Swedish Council for Information on Alcohol and Other Drugs* (CAN, 2012), using the same method of measurement for several years in a row, reveal much the same trends as seen in Europe with some important exceptions (Henriksson & Leifman, 2011; EMCDDA, 2011). From 2007 to 2011 adolescents in the second grade and secondary high school report a relatively stable use of tobacco, with a minor decrease in cigarette use and snuff use (see Figure 1). The consumption of alcohol has decreased over the last years and the most dramatic decrease since 2007 is found among males (see Figure 2). For example, the reported total consumption of alcohol during the last 12 months has decreased by 27 %: from 75 dl pure alcohol on average in 2007 to 55 dl (the figures for females were 42 dl in 2007 and changed to 34 dl in 2011; see Figure 2).



*Figure 1.* Tobacco use among Swedish male and female adolescents second grade, secondary high school (CAN, 2012).



*Figure 2.* Alcohol use among Swedish male and female adolescents second grade, secondary high school (CAN, 2012).

Compared to adolescents from other European countries, who report a decrease in illicit drug use, Swedish male adolescents instead report an increase of illicit drug use (see Figure 3). Similar pattern can also be seen regarding attitudes towards the potential harm of occasional cannabis use (e.g. using cannabis 1-2 times; see Figure 4). Thus, there seems to be a trend in Swedish male adolescents' towards higher lifetime prevalence of illicit drugs, more frequent usage and more liberal attitudes, especially towards the use of cannabis.

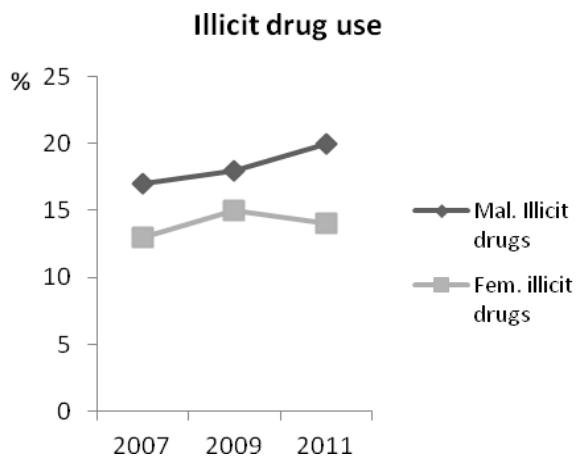


Figure 3. Illicit drug use among Swedish male and female adolescents second grade, secondary high school (CAN, 2012).

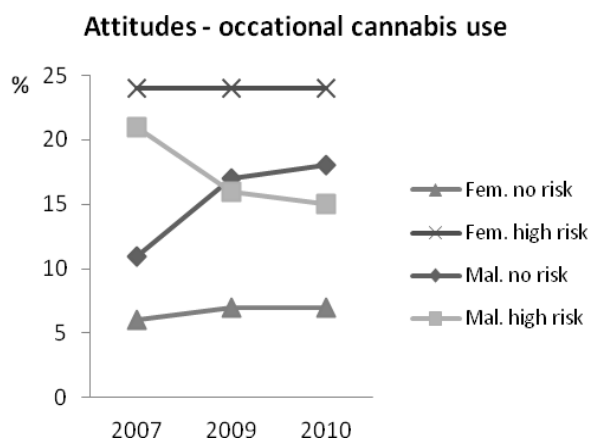


Figure 4. Attitudes towards occasional cannabis use among Swedish male and female adolescents second grade, secondary high school (CAN, 2012)

A question is whether use/excessive intake of addictive substances during adolescence increases the risk for developing dependence later on in life. For example, studies performed in the USA regarding illicit drugs have shown that 9 % of lifetime cannabis users and 23 % of lifetime heroin users will meet the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; APA 1994) criteria for substance dependence later in life. Similar prevalence figures are

found in other western countries (Anthony, Warner & Kessler, 1994; Hall, Teesson, Lynskey & Degenhardt, 1999).

There are no available data with exact prevalence figures for substance abuse and dependence among adolescents in Sweden. Some estimates of prevalence can, however, be found based upon statistics available from the *Swedish National Board of Health and Welfare* as well as the *Statistics Sweden*. Data are for example available regarding the total number of adolescents at age 15-19 years who have been in treatment for mental and behavioral disorders induced by psychoactive substance use in the years 2000 and 2010. From 2000 to 2010 the total frequency of adolescents in treatment increased by 49 %, and in relation to general population, the frequency increased by 20 % (Swedish National Board of Health and Welfare statistical database, 2012; see Table 1). These changes can to some extent reflect the increase in general prevalence figures regarding intensive consumption and more regular substance use, seen in groups of adolescents using substances, during the last decade in Sweden (Henriksson & Leifman, 2011).

Table 1. *Swedish adolescents aged 15-19 who have been in treatment for mental and behavioral disorders due to by psychoactive substance use in years 2000 and 2010 (the Swedish National Board of Health and Welfare statistical database, 2012).*

	<b>In treatment 2000</b>				<b>In treatment 2010</b>			
	Males	Females	Total	Patient / 100 000 inhabitants	Males	Females	Total	Patients / 100 000 inhabitants
<i>Total in Sweden</i>	810	721	1531	302	1 238	1044	2 282	363

## Health consequences of using substances

Adverse health effects of substance use can, according to Degenhardt and Hall (2012), be divided into four broad types; (1) the acute toxic effect (e.g. illicit drug overdose and psychosis), (2) the acute effect of intoxication (e.g. accidental injury and violence related to alcohol intake), (3) development of dependence and (4) adverse health effects of continued regular use (e.g. chronic somatic disease and mental disorders). Studies have shown associations between substance use and various adverse health effects (e.g. Degenhardt & Hall, 2012). However, deciding whether such associations are causal is more difficult since causality is heavily depending on used research methods for finding potential associations (e.g. Degenhardt & Hall, 2012). Statements concerning causality thus require evidence of a reliable association between level of drug consumption and adverse health effect (e.g. disease or injury). Categorisation of various levels of substance use in adolescents can be difficult to establish and describe. For adults, substance use disorders are clearly stated and classified in DSM-IV (APA, 1994) or in the *International Classification of Diseases-10* (ICD-10; WHO, 2010). These categorisations are, however, not always applicable to adolescent since younger people exhibits fewer symptoms of abuse/dependence although they can have more complex patterns of substance use (Harrison, Fulkerson & Beebe, 1998; Sussman, Skara & Ames, 2008).

Definitions and categorisations of substance consumption, not classified as abuse and dependence, are however less clearly stated. There is for example no international consensus regarding definition of minor levels of substance consumption. Different definitions have been proposed, for example the term “risk consumption of alcohol” which often refers to the consumption as “hazardous use”, meaning that using the substances can lead to negative social

and/or health consequences (e.g. Gmel, Kuntsche & Rehm, 2011). Other suggestions of classification are (1) *experimental use*, a stadium where most adolescents are trying a drug, but do not continue its use, (2) *situation conditional use* where the use is linked to a specific social context (for example, a trip abroad or a music festival) and (3) *controlled use* where the drug use is a recurring event, but not the dominant activity in life (Svensson, 2007). Additional examples of classifications are *minimal experimenters*, *late starters* and *escalators* (Wills, McNamara, Vaccaro & Hirky, 1996). Hence, it has been discussed that an efficient way of describing adolescent substance use may not be by using categories such as DSM-IV criterias (e.g. Harrison et al., 1998; Sussman, Skara & Ames, 2008). When describing the severity of adolescents' levels of substance use it should also be related to age and individual development status, proposing higher levels of use in elder adolescents (Wagner, 2008).

Establishing casual links between substance use and negative health consequences is thus complex and complicated. Further research in this area is thus important. For example, the *World Health Organization* (WHO) have stated that by the year 2020 mental and substance use disorders will surpass all physical diseases as a major cause of disability worldwide (WHO, 2008). Use of tobacco is regarded as one of the leading causes of premature death and is associated with approximately 5 million deaths per year worldwide. If present trends continue, approximately 10 million smokers per year are projected to die 2020 (WHO, 2008). Alcohol use related disorders are the most significant disease categories for the global burden of disease, especially for men (Rehm et al., 2009).

Concerning the adolescent period, five percentages of all deaths in young people between 15-29 years worldwide can be related to alcohol use. The majority of

those alcohol-related deaths are linked to accidents (Gore et al., 2011; Rehm et al., 2009). Potential adverse health effects of substance use are more often related to acute toxic effect and acute effect of intoxication (e.g. accidental injury and violence related to alcohol intake) in adolescents than when compared to adults. Relatively few adverse health effects from dependence and continued regular use (e.g. chronic somatic disease) will be manifested during the adolescent years. However, regular use of substances has shown to have a major impact on future mental well-being, which in turn may be linked to different types of negative health outcomes (e.g. Volkow & Li, 2005). For example, excessive intake of alcohol at an early age may have long-term effects on brain maturation and neurocognitive functions (Spear, 2002). Early onset of excessive alcohol consumption is also associated with anxiety proneness later in life (Berglund, Fahlke, Berggren, Eriksson & Balldin, 2006).

Research reports regarding illicit drug use have shown that opioid, cocaine and amphetamine use are related to a higher risk of more adverse health outcomes than cannabis use (e.g. Degenhardt & Hall, 2012). For example, a fatal overdose is a well-known risk for most illicit drugs but seldom, if ever, related to cannabis use. Cannabis is often considered as a “soft” substance comprising less potential harm than other illicit substances. Cannabis is also by far the most frequently used illicit substance among adolescents in Sweden and other western countries (Henriksson & Leifman, 2011; EMCDDA, 2011). Over the past decades, the possible associations between cannabis use and development of psychotic illness have, however, been debated. Moore and colleagues have presented findings which support causal links between cannabis and psychotic illness (Moore et al., 2007). They stated, based upon cumulative evidence, that it should be considered beyond doubt that frequent cannabis use increases the risk of developing psychotic illness. This conclusion received further support in recent research (e.g. Rössler, Hengartner, Angst & Ajdacic-Gross, 2011). Heavy

cannabis use also seems to be associated with deficits in cognitive functions regarding attention, executive function, and memory which may negatively influence neuromaturation and cognitive development (Lundqvist, 2005; Medina et al., 2007; Fernandez-Serano, Pedres-Gartzia, & Verdejo-Garcia, 2011). Use of other major illicit drugs, such as opioids and stimulants, are also related to similar alteration in neuropsychological domains (e.g. episodic memory, emotional processing and executive components). Specific substances seem however to affect particular neuropsychological domains more extensively than others (Fernandes-Serrano et al., 2011; Lundqvist, 2010).

Adolescent substance use is also found to be associated with general health problems later in the adult life. For example, high consumption and/or frequent use of substances during adolescence is linked to a substantially lower level of adult physical health, higher reliance on monetary support from social services, higher rates of criminal convictions and higher premature deaths (e.g. Stenbacka & Stattin, 2007; Larm, Hodgins, Molero-Samuelsson, Larsson & Tengström, 2008). In addition, the majority of adults with substance abuse problems begin to use substances during their adolescent years (e.g. Winters & Lee, 2008; Griffin & Botwin, 2010). Hence, regular use of substances in adolescence can be seen as a risk factor or indicator of possible future health-related problems. Further attention and focus on adolescents' health development is thus necessary in order to reduce societal costs as well as individual suffering (Gore et al., 2011).

## Theories of substance use

Since the beginning of the last century various scientifically based theories have been developed in order to understand the mechanisms of substance use. New

theories are often based upon previous theories followed by additional experiences and research. Few of the previous theories vanish totally which can explain why there are a number of theories concerning substance use and addiction today. Another explanation for the wealth of theories is that while many focus on selected aspects of the problem, they originate from different scientific disciplines and thus suggest different explanations for the problem (Leonard & Blane, 1999). In order to grasp the complexity of substance use, different compilations and overviews of existing theories have been presented; e.g. Petraitis and colleagues (Petraitis, Flay, & Miller, 1996) reviewed some central theories of adolescent substance use; Leonard & Blane (1999) presented some major psychological theories of drinking and alcoholism; West (2006) presented a review of 30 more influential theories within the area of substance use and addiction from a psychological stand point. Example of one theory that often is mentioned regarding adolescents' substance use is the *self-medication theory*. This theory has gained much attention in explaining the relation between mental health problems and substance use. The theory holds that adolescents are using substances in order to escape or reduce feelings of uneasiness and distress. Some individuals are more prone to substance use because they are less able to handle or cope with negative feelings (e.g. Hall & Queener, 2007). Other examples of theories regarding adolescents' substance use emphasize the role of the individual's personality profile, which includes behavioural, emotional and cognitive styles. For example, based upon the five factor model of personality (e.g. Digman, 1990) or the seven factor model of personality (Cloninger, Sigvardsson & Bohman, 1996), high levels of the personality traits of extroversion, antagonism, harm avoidance and/or reward dependence are found to be associated with substance use (e.g. Cloninger et al., 1996). Personality traits related to impulsivity, sensation seeking and self-control have also gained attention. Theories hold that low impulse control, high sensation seeking and/or dysregulation in the ability to inhibit behaviors which are rewarded, are crucial



in explaining the risk of substance use in adolescents (e.g. Lubman, Yücel, & Pantelis, 2004). There are also numbers of significant theories regarding adolescents' beliefs about the consequences of experimenting with specific substances, which in turn contribute to the decisions to use (e.g. Ajzen, 1991). Furthermore, theories assume that adolescents acquire their beliefs about substance use and other delinquent behaviors from their role models, friends and parents. Examples of theories that fall in to this category are social cognitive learning theory (e.g. Bandura, 1986) and the social development model (Hawkins, Catalano, & Miller, 1992). In addition there are other theories, originating from a combination of psychological and pharmacological research, which focus on the positive rewarding effect of substance use and the increasing risk of developing misuse and dependence. For example the dopamine theory of drug reward includes the individual difference in sensitivity to positive rewarding effect that dopamine receptors play in substance use. The theory postulates that an individual's subjective response to the potential reinforcing effect of a drug is linked to individual and heritable characteristics, as well as behavioural genetics (e.g. Volkow et al., 2009).

Since there are such a variety of theories related to substance use, attempts have been made to combine components from several different theories into one. These so called comprehensive theories account for how adolescents' biology, personality, relationships with peers, parents, culture or environment interact to initiate substance use and to develop misuse. There are, according to West (2006), few truly synthetic comprehensive theories that capture all major aspects of substance use and addiction. Examples of attempted comprehensive theories are the *Problem behavior theory* (Jessor & Jessor, 1977) and the *Synthetic theory of motivation* (West, 2006) which include parts from various scientific disciplines and approaches. No general comprehensive theory applicable to all individuals and situations has yet been accepted by a majority of the scientific

society as the most central and complete theory of explaining and understanding substance use (West, 2006).

In line with thoughts about comprehensive theories, one way of understanding the complexity of substance use is by considering several aspects of a person's life and not sticking to a specific theory (e.g. Arthur, Hawkins, Pollard, Catalano & Baglioni, 2002). Taking a more holistic view of the person's current life situation requires a multi-factorial perspective, including biological, psychological and social aspects of the problem. Over the last twenty years, researchers have therefore tried to understand the reasons for using substances from a so called risk factor perspective (e.g. Hawkins et al., 1992). The risk factor approach is not to be considered as a specific theory but offers a way to probe which adolescents are most prone to substance use, and which are at the highest risk of developing dependency and misuse.

## **Risk factors**

There is a substantial amount of research on factors associated with increased risk of substance use among adolescents. Before presenting some of these findings a brief overview of the terms related to the concept of risk will be addressed.

### **Definition of risk**

Risk is simply said to be the probability or likelihood of a particular event to occur. Risk is not a static state or concept and an identified risk can increase or

decrease with the individuals age. Neither can risk of a particular outcome be assumed to be the same, or to be of the same strength, in different populations. Risk also varies depending on the state of the outcome variable, for example is risk factors for the onset of illicit drug use among adolescents to some extent different from those associated with development of dependence (Kapur, 2000; Offord & Kraemer, 2000). There exists several definitions of risk and terms related to the concept risk (see Table 2). A risk factor can be defined as a measurable characteristic in a group of individuals or a situation that precedes negative outcome for a specific outcome criterion. When risk factor changes, and also the outcome variable as a consequence of that, it can be labelled as a causal risk factor. When a variable is either positively or negatively associated with an outcome, but does not preceding the outcome, it can be defined as a correlate (Offord & Kraemer, 2000).

Risk factors and other variables may interact and affect each other and therefore the output can be a result of a complex causal chain (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001). There are different trajectories were different factors play different roles in order to initiate for example substance use and development of dependence among adolescents. Moreover, a risk factor can affect adolescents at different ages and stages of their lives diversely. The impact of risk factors may therefore vary with the developmental state of the individual (e.g. Brown et al., 2008; Cleveland, Feinberg, Bontempo, & Greenber, 2008; Harris-Abadi, Shamblen, Thompson, Collins, & Johnsson, 2011).

Table 2. *Examples of different terms associated with the construct risk.*

<b>Term</b>	<b>Definition</b>	<b>Example</b>
Risk	Increased probability of an undesired outcome to occur	The odds of developing substance abuse are higher for groups of individuals having biological parents with this disorder
Risk factor	A measurable characteristic in a group of individuals or a situation that predicts negative outcome for a specific outcome criteria	Parental substance use
Cumulative risk	Increased risk due to presence of several risk factors	Many risk factors e.g. having parents and grandparents with substance use disorders
Proximal risk	Risk factors experienced directly by the individual	Offered cannabis from peers
Distal risk	Risk arising from an individual's context	High levels of cannabis availability
Initiating risk	Factors important for the onset of a specific disorder	Sensation seeking personality
Maintaining risk	Factors important for the maintaining of a specific disorder	Associating with delinquent peers
Dynamic risk	Factors relatively changeable	Positive attitudes towards cannabis use
Static risk	Historical, stable, unchangeable factors	Childhood trauma
Protective factor	A protective factor refers to anything that prevents or reduces vulnerability for the development of a disorder	Caring adults Effective school programs against substance use

Factors found to be health promoting and associated with increased health development are labelled protective factors. These factors can be the opposite of risk factors, or be seen as factors reducing the effect of risk factors, resulting in reduced occurrence of for example substance use. Protective factors can equalize the onset of substance use by reducing risk or for example preventing negative chain reactions. Resilience can be defined as the ability to cope with adversity in spite of a situation that one might not be able to change (Fergus, & Zimmerman, 2005).

## Research on risk factors for substance use

Since the use of different substances is influenced and affected by various variables, it can be difficult to categorise risk factors as well as draw conclusions between one specific variable and the outcome. Nevertheless, there are a number of identified risk factors which have been shown to be associated with the use of different types of substances among adolescents and it appears that exposure to multiple risk factors has a cumulative effect. Moreover, one risk factor is rarely associated with use of only one substance. There seems to be a generalized risk of using different substances and these substances appears to share some fundamental risk factors (e.g. Palmer et al., 2009).

Factors associated with adolescents' substance use are often categorised into different groups or domains related to potential interventions for each domain. Risk factors can, for example, be grouped according to their ability to affect the risk of substance use directly or indirectly. Other categorisations are pursuant to their levels of changeability. Static, historical risk factors are more difficult to change, if at all possible, while dynamic risk factors may be changed more easily. One categorisation used is in three separate domains; *Structural* (e.g. school, community), *Interpersonal* (e.g. relationship to others such as family and peers) and *Individual* (e.g. individual characteristics such as personality traits).

### *Structural risk factors for substance use*

Factors considered as being outside an individual's control can be labelled as structural risk factors or macro-environmental factors (see Table 3). For example, the individuals' and their family's socio-economic status are found to be associated with substance use, where lower status is associated with increased

risk of substance use. Living in a deprived neighbourhood, with high crime rate and other social problems, is also found to be related to substance use (Daniel et al., 2009). In addition, the school environment and school management are also linked to substance use, where poor school situations increase the risk of using substances such as illicit drugs (Frischer et al., 2007). Moreover, the availability of illicit drugs within the individual's environment is found to be related to use of substances. The society's intention, acceptance, tolerance and legalisation regarding illicit drugs also affects the adolescents' choice of using illicit drugs or not, although in a more indirect way (Spooner, 1999). Further ethnicity can be considered as a risk factor, where ethnic minorities in western societies can show an increased risk of illicit drug use (Olsson et al., 2003).

Table 3. *Examples of structural risk factors associated with adolescents' substance use.*

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**Structural risk factors**

- 
- Drug availability and price
  - Socio-economic status
  - School management, environment
  - Deprived neighbourhood
  - Media influences
  - Societal substance use attitudes
- 

*Interpersonal risk factors for substance use*

Factors considered to be related to the individual's social situation, such as relationship with friends and family or other close relations, can be addressed as interpersonal risk factors (see Table 4). Several studies have shown that individuals with relationships to peers using illicit drugs have an increased risk

of using drugs themselves (e.g. Creemers, Dijkstra, Vollenbergh, Ormel, Verhulst, & Huizink, 2009; Fergusson, & Meehan, 2011). There is also a relationship between adolescents' illicit drug use and having peers who express positive attitudes to drug use, although the peers have never used illicit drugs (Steinberg, 2005). Furthermore, having delinquent peers or peers expressing antisocial attitudes is also associated with increased risk of drug use for the individual (Kokkevi et al., 2007). However, the impact of peers' influence on an adolescent's habit is not obvious. For example, substance abusing peers do not suddenly appear in an adolescent's life, pressuring the adolescent to use substances. Rather, adolescents prone to rule breaking behaviour are more likely to affiliate with peers sharing the same attitudes, creating a group environment supporting rule breaking behaviour and thereby exerting pressure on the individual to conform to those attitudes in order to sustain membership in the group or to be accepted by others. One of the most common rule breaking behaviours endorsed by such groups is the use of various substances (e.g. Coggans & McKellar, 1994; Laursen, Hafen, Kerr, & Stattin, 2012; Steinberg, 2005). Research has also found relations between poor family environment and increased importance of the adolescent's peers, which in turn increase the possibility of the individual being influenced by these peers (Stattin, & Kerr, 2000).

Example of risk factor associated with the individual's family is adverse childhood experiences, mostly due to a destructive and negative family environment (Barrett, & Turner 2005; Lynskey et al., 2002). Further examples of negative family interactions, associated with substance use, include low parental discipline (King & Chassin, 2004), family cohesion (Hoffman, & Cerbone, 2002) and deficient parental monitoring (e.g. Case, & Haines 2003; Hemovich, Lac, & Crano, 2011; Stattin, & Kerr 2000). Studies have also found that siblings can have a major impact on whether a person will use substances or

not (Kokkevi, Arapaki, Richarson, Florescu, Kuzman, & Stergar, 2007; Merikangas, & Avenevoli, 2000). Moreover, children of parents with substance use problems have an increased risk of developing their own substance-related problems later in life, compared to children of parents without such problems. Also, the presence of mental health problems within the family is shown to be associated with the development of substance-related problems (e.g. Heiman et al., 2007; Kendler et al., 2000; Li, Pentz, & Chou, 2002; Merikangas, & Avenevoli, 2000; Reinherz et al., 2000). Additionally, the adolescent's family structure, e.g. single-parent families, can be a factor influencing the risk of problematic substance use. Also, parental divorce has shown to be related to substance use (Barrett, & Turner, 2005; Hemovich, & Crano, 2009; Lynskey et al., 2002).

Table 4. *Examples of interpersonal risk factors associated with adolescents' substance use.*

---

**Interpersonal risk factors**

- 
- Peers' attitudes, behaviour
  - Negative family environment
  - Parental monitoring
  - Mental and substance related problems in parents and siblings
  - Single parent home
- 

*Individual risk factors for substance use*

Factors that are specifically related to the individual and to a lesser extent influenced by environmental factors can be considered as personal or individual



risk factors (see Table 5). From a developmental perspective, studies have shown that individual risk factors, such as personality traits, attitudes and gender, have a higher impact during late adolescence while family factors have higher impact during childhood and early adolescence (Winters & Lee, 2008).

Generally speaking, risk taking is found to be more common among young males than young females. Thus, male adolescents are more often involved in risky unhealthy activities such as intake of illicit drugs (e.g. EMCDDA, 2011; Gullone & Moore, 2000; von Sydow, Lieb, Pfister, Höfler & Witschen, 2003).

Table 5. *Examples of individual risk factors associated with adolescents' substance use.*

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**Individual risk factors**

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- Gender
  - Personality traits
  - Mental health problems
  - Heritable vulnerability
  - Adverse life events, trauma
  - Positive attitudes and intentions
  - Developmental stages e.g. puberty
  - Early onset of substance use
  - Delinquency
  - Conduct disorder
  - Co-morbidity - internal and external disorders
- 

Another individual risk factor associated with adolescents' substance use is the occurrence of parents with substance use problems, e.g. the heritable or genetic component when controlling for environmental factors. Several studies have

found associations between having parents with substance use and an increased risk of developing one's own substance-related problems (e.g. Kendler et al., 2012; Lynskey, Agrawal, & Heath, 2010; Merikangas & Avenevoli, 2000; Verweij et al., 2009). Studies have also found that problematic substance use is more related to genetic heritage whereas age at first use is more influenced by environmental factors (Rhee et al., 2003, Heiman et al., 2007). Moreover, Young et al. (2006) have suggested that problematic substance use is affected by genetic influences, whereas shared environmental influences may be more substance-specific.

A further factor of importance is the individual's personality profile which includes behavioural, emotional and cognitive styles. Personality traits such as hostility and low self-esteem are suggested to be positively associated with substance use as well as negative affectivity or neuroticism (Butler & Montgomery, 2004; Hoffman & Cerbone, 2002; Ruiz, Pincus & Dickinson, 2003; Ruiz et al., 2003; Vollrath & Torgersen, 2002; Walton & Roberts, 2004). Some studies have, however, reported contradictory results indicating that neuroticism rather is a protective personality trait for substance use (Ham & Hope, 2003; Kashdan et al., 2005; Kirkcaldy, Siefen, Surall, & Bischoff, 2004). Moreover, it is established that the behavioural trait of impulsivity is an essential risk factor for the development of substance use problems and dependence among adolescents (e.g. Volkow et al., 2009; Gullo, & Dawe, 2008; Ivanov, Schulz, London, & Newcorn, 2008).

Long-lasting stressful periods, experience of early severe stress and/or traumatic life events in childhood can affect an individual's personal development resulting in an enhanced risk for substance use (Andersen, & Teicher, 2009; Gordon, 2002). Occurrence of mental health problems is another individual factor often associated with use of substances. Thus, psychiatric disorders such

as anxiety problems and different types of personality disorders may increase the likelihood of using substances (Armstrong, & Costello, 2002; Hoffman & Cerbone, 2002; Jané-Llopis & Matytsina, 2006; Kirkcaldy et al., 2004; Rao & Chen, 2008). Also psychiatric disorders of depression or depressive symptoms are found to increase the risk of developing substance use problems and dependence (e.g. Comeau, Stewart & Loba, 2001; Swendsen & Merikangas, 2000; Tarter et al., 2003). Previous symptoms of depression are found to increase the risk of later substance use and the initial symptoms directly or indirectly increase the risk of developing dependence and other mood disorders. A reverse casual association has also been proposed where extensive and prolonged substance use may induce symptoms of depression (Swendsen et al., 2010).

Adolescents' previous experience of using legal substances, such as tobacco and alcohol, may have an impact on whether they will use illicit drugs or not. For example, early onset of tobacco use and/or alcohol intake, as well as frequent and extensive use of these substances, may increase the probability of also using illicit drugs later in life (Wadsworth, Moss, Simpson & Smith, 2004). Moreover, age at first use has found to be related to the use of other substances as well as the increased risk of developing dependence (Hofler et al., 1999; von Sydow et al., 2002). For example, of those who begin drinking before the age of 14, rates of lifetime dependence on alcohol are 3-4 times higher compared to those with a debut after age 20 (Grant & Dawson, 1997). Positive emotional and cognitive experiences of illicit drug use seem to predict substance use problem and dependence later in life (Fergusson et al., 2003; Grant et al., 2005). Increased rates of individuals' positive effects of illicit drug intake are found to be associated with increased rates of dependence (Zeiger et al., 2010). Individual variations in the subjective effect of the substance used has been found to be related to differences in functionality in specific neural systems such as the

dopaminergic or endocannabinoid systems (e.g. Dlugos et al., 2010; Volkow et al., 2009).

An additional risk factor that also is of interest to discuss in relation to possible increased risk of using illicit drugs is the adolescent's intention of future use (Ajzen, Timko, & White, 1982; McMill & Conner, 2003). Intentions to perform a specific behaviour can, according to the theory of planned behaviour, predict human action later on in life (Ajzen, 1991). Intention to perform a behaviour is determined by an individual's attitudes toward the behaviour (positive or negative evaluations of performing the behaviour), by subjective norms (perceptions of approval or disapproval from significant others regarding performing the behaviour) and by perceived behavioural control (appraisals of their ability to perform the behaviour). The theory also takes into account that there are factors of importance for influencing future behavioural outcomes, such as gender, personality traits and demographical factors (Ajzen, 1991). Studies of the applicability of the theory of planned behaviour, in relation to future substance use, have shown that the model provides satisfactory prediction of, for example, marijuana use in young adolescents (e.g. Ajzen et al., 1982). This suggests that intention of future illicit drug use can be used as a possible risk factor for assessing the risk for actually use in the future.

Taken together, there is a comprehensive body of research regarding factors associated with increased risk of substance use among adolescents. However, studies emphasize the difficulty in determining associations between risk factors and substance use, as well as the variety of impacts for each different risk factor. This complexity should also be set in relation to each individual's specific situation (e.g. Brown et al., 2008; Hawkins, 1992; Spooner, 1999). From a developmental perspective, studies show that individual risk factors, such as personality traits and attitudes, have higher impact during late adolescence than

for example family factors which have higher impact during childhood and early adolescence (e.g. Winters & Lee, 2008). Even if no single risk factor alone is crucial for the development of substance use disorder some risk factors have significantly higher impact in the progress towards adolescents' later use and misuse (e.g. Cleveland, Feinberg, Bontempo & Greenberg, 2008). This thesis therefore focuses on significant individual factors relevant for the late adolescent period.

# AIMS

The three studies included in this thesis aimed to investigate possible individual psychological factors associated with adolescents' use of substances such as tobacco, alcohol and illicit drugs, with specific focus on factors associated with increased risk of using illicit drugs.

*Study 1* aimed to investigate if personality traits, assessed by the Health relevant five factors Personality inventory (HP5i; Gustavsson et al., 2003), are associated with risk consumption of tobacco, alcohol and illicit drugs in adolescents. An additional aim was to validate HP5i in a population of adolescents since the inventory has so far only been validated for adults.

*Study 2* aimed to investigate individual oriented factors, specifically adolescents' intentions of using illicit drugs in the future and their subjective drug effect. In order to examine intention, this variable was related to several well known factors associated to illicit drug use. Thus, factors such as gender, personality traits, symptoms of mental health problems, subjective drug experiences, regular and excessive use of tobacco and alcohol, as well as family settings, were examined at one and the same time in relation to actual and intentional drug use.

*Study 3* aimed to investigate if the personality trait impulsivity, depressive symptoms and positive experiences of illicit drug use, combined in profiles (clusters), can differentiate illicit drug use among adolescents in the general population. Furthermore, this study aimed to validate the profiles in a clinical sample of substance using adolescents as well as analysing the relation between profiles and other well known risk factors for adolescents substance use.

# METHODS

Respondents included in the three studies of this thesis were recruited from a general population of secondary high school students in third grade, in the region of Västra Götaland, Sweden. The research design is cross-sectional meaning that the respondents are observed at one specific point in time.

## Sample selection

### Total population

In order to identify the total number of secondary high schools as well as number of students in third grade per high school in the region of Västra Götaland, the Swedish national agency for education statistical service (SIRIS) were contacted. Data from SIRIS revealed that the region of Västra Götaland had a total of 106 schools and 17 254 students year 2005 (Figure 5).

A total of 31 schools and 1230 students were, however, excluded from this population for different reasons. For example, one school was used for focus group analysis prior to the main investigation. This school was thus excluded, and also four other schools since it was difficult to find the correct addresses, contact persons and/or decision makers. Furthermore, in order to guarantee the anonymity of each participating respondent, only schools with a minimum of 40 students per school were included. Therefore, 26 schools were additionally excluded from the total population. After excluding these schools, a selected population of 75 schools and 16 051 student remained for the project.

## Selected population

All the 75 schools were invited, via a letter to the principal of the school, to participate in the study. Out of them, 27 principal accepted that their secondary high schools could participate in the study. This gave a selected population of 4799 students in third grade (see Figure 5).

The most frequent reasons for not contribute in the study, according to the principals, were:

- Have just recently performed a substance use survey (a substance use survey had been performed by the City of Gothenburg the year before)
- Have not time to participate in a study, give priority to work with preventive interventions instead
- The students are tired of answering surveys
- Teachers and personal in school administration are tired of administrating surveys

Statistical analyses were performed in order to analyse if the sample of 27 schools were biased compared to the selection sample. Variables included in the analysis were school type (e.g. communal, private, region), number of students, proportion of females, proportions of adolescents with immigrant background, type of communal (e.g. major city, suburban, countryside communal). Chi-two analyses were performed and no differences between the sample and selection sample were found indicating no systematic loss of school regarding the investigated variables.



## Sample population

In total were 4799 questionnaires distributed to the 27 schools. The senior high school students were asked to fill out a self-administered paper-and-pencil questionnaire and the study was carried out in the participants' classrooms. All students were informed that participation was voluntary and assured of the confidentiality of their responses. 3470 questionnaires returned from the schools. The most frequent reasons for not answered and/or returning the questionnaires, reported by the person who administered the questionnaires at each of the 27 schools, were:

- Students were absent at the time when the survey was performed
- Students were not present for example due to practice periods
- Students were present at time for fill out the questionnaire, but refrained to answer
- Mismatch between number of students according to the central lists and actual number of students present at the specific school

## Actual study group

Out of the 3470 questionnaires, 51 questionnaires were excluded from the study according to in advance set criteria for exclusion. Reasons for exclusion were, for example, obvious fake answers (meaning systematic and contradictive response rate) as well as uncompleted questionnaires (a handful of all questions answered). As a result, the finally investigated population consisted of 3419 students in third grade (see Figure 5).

Statistical analyses were performed in order to reveal if some of the 27 schools contributed significantly more to the loss of respondents. Variables included in the analysis were number of distributed questionnaires, number of returned questionnaires and number of adjusted questionnaires. Chi-two analyses were performed and no differences between the samples were found, indicating that no systematic loss of respondents was affecting the selection.

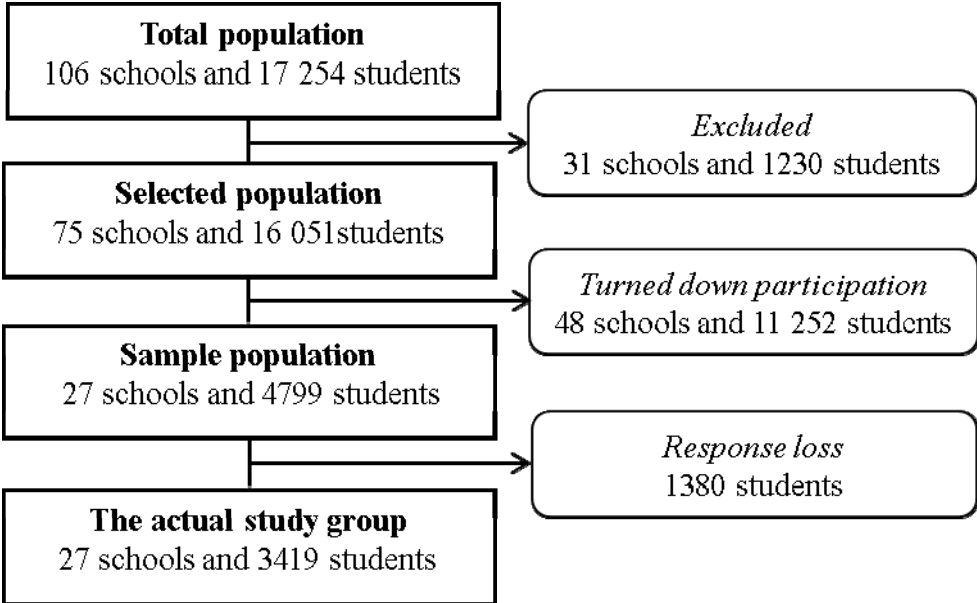


Figure 5. *Process of sample selection of participants to the studies included in this thesis.*

Adolescents included in *Study 1* and *Study 2* was the 3419 students in third grade; 1636 were males and 1783 females (48 % and 52 %, respectively). The median age for both sexes was 18 years.

Out of the actual study group of ( $n = 3419$ ), 16 % of the adolescents reported a history of illicit drug use ( $n = 566$ ; male:  $n = 282$  and female:  $n = 274$ , 51 % and 49 %, respectively). This subgroup of individuals was included in *Study 3*.

Data presented in *Study 3* also included a clinical sample of adolescents who had been admitted to an out-patient treatment unit for adolescents with substance misuse problems ( $n = 133$  individuals; male = 68 and female = 65; 51% and 49%, respectively; mean age 16,7 years). The adolescents were asked to participate in the study at their first visit at the treatment unit. They filled out a self-administrated paper-and-pencil questionnaire at the treatment unit and they were also informed that participation was voluntary and assured of the confidentiality of their responses.

Ethical approval for the project was granted from the Regional Ethical Review Board at the University of Gothenburg, Sweden.

For a detailed description of the methods and procedures used in *Study 1, 2* and *3*, see respective study.

## **Instruments**

The senior high school students as well as the patients from treatment unit (*Study 1, 2* and *3*), answered the questionnaire consisted of demographic variables (e.g. sex and gender), habits of substance use (e.g. tobacco, alcohol and illicit drugs), functioning of personality (e.g. personality profile and symptoms of mental health problems), occurrence of problems within the biological family (e.g. substance use and mental health problems) and attitudes towards illicit drug use.

For a detailed description of the instruments used in *Study 1, 2* and *3*, see respective study.

## Statistics

In *Study 1* and *2* bivariate and/or multinomial logistic regression analyses were used in order to estimate the odds ratios (OR) for factors associated with substance use. In addition, the chi-square test and/or ANOVA (followed by the Tukey's post-hoc test) were used for analysing between-group differences. Multiple regression models were used to analyse excessive illicit drug consumption. Moreover, the fit of the HP5i measurement model in *Study 1* was tested by using confirmatory factor analysis (CFA). In *Study 3* cluster analytic techniques were used to identify homogeneous clusters of individuals. In order to reveal differences between clusters chi-square test and/or ANOVA were used.

For a detailed description of the statistical analyses used in *Study 1*, *2* and *3*, see respective study.

### Analyses of missing data

Missing data and internal drop out were analysed based upon variables used in *Study 2* (analyses in *Study 2* included most respondents and variables). Missing data for each variable were first identified ranging from 0,3-6 %. A variable were then created counting missing data for each variable. Eighty percentages of all respondents were found answered all variables analysed in *Study 2*. This variable were then compared to variables included in the questionnaire but not used in the analyses of *Study 1,2* or *3* and that showed high response rate (under 1%). These analyses reveal that respondents who answer all questions report significantly higher levels in the variables of positive emotions and life satisfaction than those who answer fewer questions. Thus, these results indicate

an underestimation of levels of mental health problem in the sample that potentially bias the analysis performed in the three studies.

# SUMMARY OF THE EMPIRICAL STUDIES

## Study 1

### Evaluation of the HP5i model

Results from *Study 1* show that the HP5i measurement model was functionally the same for both male and female adolescents. Calculations of the study sample showed that the estimated measurement invariance model possessed acceptable fit according to previous recommended psychometric criteria (Brown, 2006). Statistical analyses of the inventory indicate that HP5i is a valid inventory when assessing personality traits in adolescents.

### Personality traits associated with risk consumption of substances

In *Study 1* personality traits, measured by HP5i, were analysed as being potentially associated with risk consumption of tobacco, alcohol and/or illicit drugs (risk consumption was defined as daily use of tobacco, alcohol intoxication over 20 times during the last 12 months and ever having used illicit drugs, see *Study 1*, Methods). As seen in table 6, significantly more males reported a risk consumption of tobacco and alcohol compared to females. No gender differences were found concerning risk use of illicit drugs or concurrent risk use of all three substance classes.

Table 6. *Percent (%) of minor substance use, risk consumption of tobacco, alcohol and illicit drugs as well as concurrent risk use of all three substance classes among males and females (modified from table 1 in Study 1).*

	<b>Total</b>	<b>Males</b>	<b>Females</b>
Minor substance use <sup>a</sup>	58	52	62***
Tobacco	26	30	21***
Alcohol	25	29	22***
Illicit drugs	18	19	16
All three substance classes	6	6	3

<sup>a</sup> *Substance use at frequencies or quantities not considered as risk consumption*  
 \*\*\*:  $P < 0.001$  (Chi-square test)

The main finding from *Study 1* was that personality traits, as measured by the HP5i, were associated with risk use of substances among adolescents. Odds ratios (OR) for the personality traits in relation to risk consumption of tobacco, alcohol and illicit drugs are presented in table 7. For each substance, several associations to certain traits were found.

As seen in table 7, it was found that the traits antagonism and impulsivity were strongest associated with risk consumption, where high levels of these traits increased the odds for risk consumption of tobacco, alcohol and illicit drugs. Association between these two personality traits and risk consumption of substances are in line with results from previous studies (e.g. Cooper, Wood, Orcutt & Albino, 2003; Ruiz et al., 2003; Vollrath & Torgersen, 2002; Walton & Roberts, 2004).

Table 7. Odds ratios (OR) with CI 95 % for the five personality traits of HP5i and gender, associated with risk consumption of tobacco, alcohol and illicit drugs as well as concurrent use of all three substance classes in relation to no drug risk consumption (modified from table 4 in Study1).

Substance use	Personality traits (OR)						
	<i>n</i>	A	I	HC	NA	AI	Gender
Tobacco	794	1,72**	1,84**	0,58**	0,85*	0,78*	1,57**
Alcohol	806	1,51**	1,83**	0,875	0,81*	0,79*	1,36**
Illicit drugs	527	1,83**	1,88**	0,52**	0,85	0,68**	1,17
All three substance classes	182	2,53**	2,85**	0,43**	0,84	0,68*	1,38

\*: =  $p < 0,05$ ; \*\*: =  $p < 0,01$

(A = Antagonism; I = Impulsivity; HC = Hedonic Capacity; NA = Negative Affectivity; A = Alexithymia).

Moreover, studies have indicated that both these traits probably portend the development of substance abuse and dependence (e.g. Cloninger et al., 1996). The finding, that low hedonic capacity was associated with risk consumption, is also in line with previous research showing that lack of energy and depressed mood often co-exist with excessive substance use (e.g. Comeau, Stewart & Loba, 2001; Cooper et al., 2003; Kashdan, Vetter & Collins, 2005; Harakeh et al., 2006; Kirkcaldy et al., 2004). Concerning alexithymia studies have shown a relationship between alcohol consumption and alexithymia. Alexithymia also seems to be involved in the progress towards problematic substance use among adults. (Lyvers et al., 2012) There are to our knowledge, however, no studies that have paid specific attention to whether alexithymia is associated with substance use among adolescents as seen in *Study 1*. Finally, negative affectivity, which assesses uneasiness and nervous tension, were shown to be the weakest trait associated with risk consumption of substances. Previous findings



of negative affectivity and neuroticism have, however, been inconsistent (Kashdan et al., 2005; Paunonen & Ashton, 2001; Smith & MacKenzie, 2006; Vollrat & Torgersen, 2002; Walton & Roberts, 2004).

The results from *Study 1* provide a rationale for advanced use of the HP5i as a complementary instrument where substance use and potential future health risks are investigated among adolescents.

## **Study 2**

In *Study 2*, psychological individual factors, suggested to be associated with illicit drug use (e.g. Cleveland, Feinberg, Bontempo & Greenberg, 2008), were analysed. Adolescents were grouped according to if they considered using /or intended to use drugs in the future and, when applicable, their reported consumption of illicit drugs. Different statistical analyses were performed between the identified groups as well as based upon reported total consumption of illicit drug. Figure 6 presents an overview of the different groupings of adolescents according to their intention of future use and their consumption of illicit drugs. The different analyses performed in *Study 2* are also presented in Figure 6.

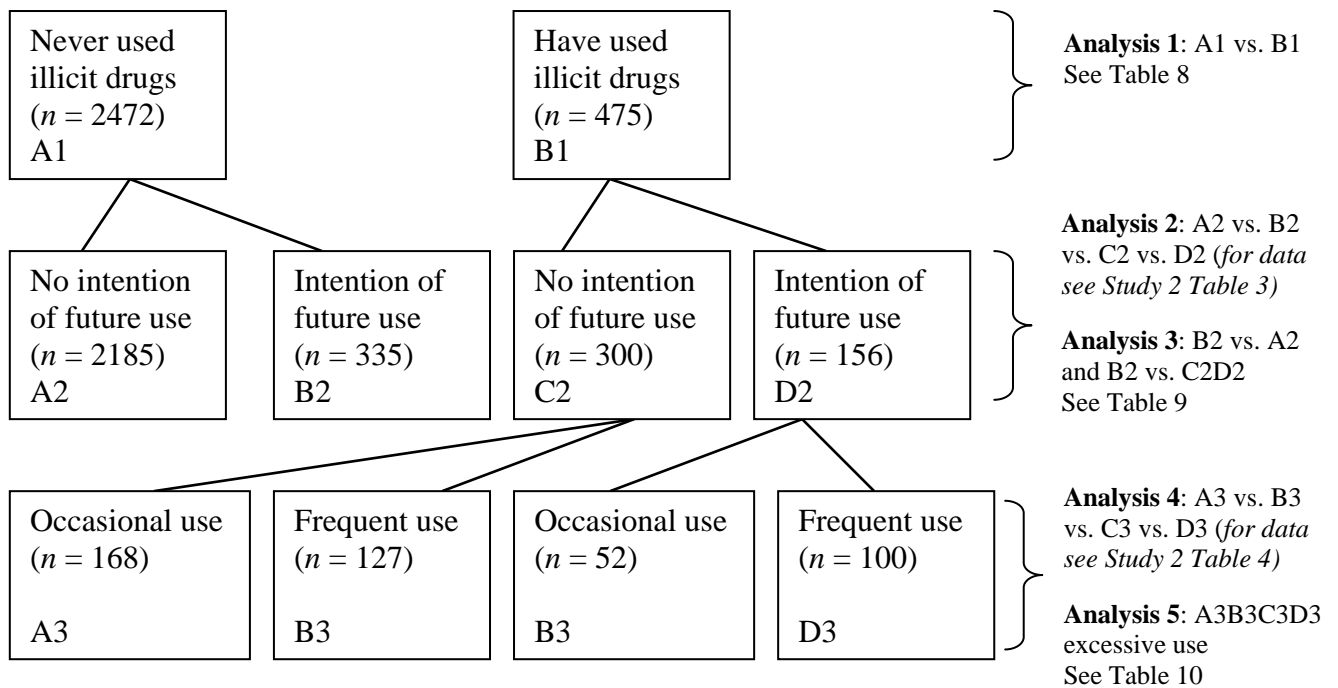


Figure 6. Overview of the different groupings of adolescents in Study 2 according to their intention of future use, consumption of illicit drugs and the analyses performed.

## Non-users *versus* Users

Results from *Study 2* show, that adolescents with a history of using illicit drugs compared with those with no such history (see Figure 6, A1 vs. B1) differed in the majority of the investigated variables. Significant factors for having used illicit drugs were, as expected and in line with previous research (e.g. Hawkins et al., 1992; Spooner, 1999), variables such as personality traits, occurrence of mental health problems, daily use of tobacco and frequent experiences of being intoxicated by alcohol during the last year (see Table 8). Moreover, mental and/or substance related problems within the biological family were also associated with illicit drug use (see Table 8).

Table 8. Odds ratio (OR) for the investigated variables in relation to using illicit drugs (n = 475). Reference group are individuals reporting never used illicit drugs (n = 2472). The table is modified from table 1 in Study 2.

<b>Factors analysed</b>	<b>OR</b>
<i>Gender</i>	
Females (%)	1,04
<i>Family problems</i>	
Mental and substance related problems <sup>a</sup>	1,27**
<i>Personality</i>	
Antagonism	1,42**
Impulsivity	1,30*
Negative affectivity	0,72*
Hedonic capacity	0,75*
Alexithymia	0,84
<i>Mental health</i>	
Anxiety	0,98
Depression	1,04**
<i>Substance use</i>	
Daily use of tobacco (%)	3,58**
Alcohol intoxication the last year <sup>a</sup>	1,47**

<sup>a</sup> Mean values represent an index, see *Methods* in Study 2

\*:  $p < 0,05$ ; \*\*:  $p < 0,01$  (bivariate logistic regression)

Adjusted  $R^2 = 0,29$  (Nagelkerke)

*Individuals with no experience of using illicit drugs: factors associated with intention of using illicit drugs in the future*

Among adolescent with no history of using illicit drugs, factors associated with the intention of future drug use were being male, antagonistic behaviours, low levels of negative affectivity and having depressive symptoms. Frequent

intoxication with alcohol was also more common in this group of adolescents with no history of using illicit drugs, but with the intention to use in the future (A2 vs. B2). Furthermore, when comparing this group with adolescents who actually had used illicit drugs (B2 vs. C2D2), characteristics such as personality traits and mental health problems did not differ significantly between the groups. The results from the present study thus indicate that adolescents with no experiences of using illicit drugs, but with the intent of future use, report risk factors known to also be involved in actual illicit drug use (e.g. Lynskey et al., 2002). This suggestion is further strengthened by the fact that they (i.e. individuals with no history of using illicit drugs, but with the intention to use in the future) also bear some resemblances, at least in some individual characteristics, to those who actually have used illicit drugs.

When comparing this group with adolescents who actually had used illicit drugs characteristics such as personality traits and mental health problems did not differ significantly between the two groups (see Table 9, right panel). Studies performed in populations of Swedish young adults (approximately 20-25 years) shows that the prevalence of using illicit drugs increases with age, especially among young men (e.g. Bullock & Röger, 2005; Palmer et al., 2009). Therefore, it is possible that male adolescents in this study with high alcohol consumption, high levels of antagonism and depressive symptoms actually will use illicit drugs later in life. It should be noted, however, that this group of males are facing an increased risk of substance use, is based on findings from a cross-sectional study and that the actual outcome cannot be verified in the present study. On the other hand, according to the established theory of planned behaviour (Ajzen, 1991), it is likely that this suggestion may be relevant. For example, several previous studies have demonstrated that this theory effectively can predict a wide range of behaviours, including illicit drug use (Armitage & Conner, 2001; McMill & Conner, 2003). Thus, this theory proposes that

intentions play an important role in guiding human action, even though the transition from intention to behaviour is complex. Then again, Gerrard and colleagues (2008), argue that models based on the theory of planned behaviour, are not the best suitable models for predicting adolescent risk behaviour. They suggest a model combining intentions (such as the theory of planned behaviour) with non-intentional, non-rational decision making, for better predicting adolescents' future behaviour (Gerrard, Gibbson, Houlihan, Stock & Pomery, 2008).

Table 9. Odds ratio (OR) for the investigated variables in relation to intention to use illicit drugs in the future. Reference group (not shown in the table) are individuals reporting never having used illicit drugs but intending to use in the future ( $n = 316$ ). The table is modified from table 3 in Study 2.

<b>Factors analysed</b>	<b>Never used illicit drugs, no intention to use in the future (n = 2091) OR</b>	<b>Have used illicit drugs (n = 431) OR</b>
<i>Gender (female %)</i>	,63**	,67*
<i>Family problem</i>		
Mental and substance related problems <sup>a</sup>	,92	1,20
<i>Personality</i>		
Antagonism	,72**	1,11
Impulsivity	,88	1,15
Negative affectivity	1,53**	,93
Hedonic capacity	1,01	,82
Alexithymia	1,09	,91
<i>Mental health</i>		
Anxiety	1,02	,99
Depression	,94**	1,00
<i>Substance use</i>		
Daily use of tobacco (%)	1,72**	6,3**
Alcohol intoxication the last year <sup>a</sup>	,74**	1,14**

<sup>a</sup> Mean values represent an index, see *Methods* in Study 2

\*:  $p < 0,05$ ; \*\*:  $p < 0,01$  (Multinomial logistic regression)

Adjusted  $R^2 = 0,27$  (Nagelkerke)

## Occasional users *versus* frequent users

Respondents with experience of using illicit drugs ( $n = 447$ ) were divided into four sub-groups according to their reported consumption (i.e. occasional [use on 1-2 occasions] or frequent use [use on more than two occasions]) and their self-reported intention whether they will use or not use illicit drugs in the future (see

also Figure 6). Thus, individuals who report occasional consumption were subdivided into *will never use again* ( $n = 168$ ; A3) and *intention to use again* ( $n = 52$ ; B3). Those who reported frequent consumption were subdivided into *will never use again* ( $n = 127$ ; C3) and *intention to use again* ( $n = 100$ ; D3). When analysing the differences between the four sub-groups, the most significant differences were found between the sub-group reporting occasional consumption and will never use again (A3) compared to the two groups who reported frequent consumption (C3 and D3). The only differences observed between the two groups of occasional consumption (A3 vs. B3) were tobacco use and positive drug experience, where those who reported intention to use illicit drugs again reported significantly higher levels of positive drug experiences.

### Excessive consumption of illicit drugs

A hierarchal multiple regression analysis was used for analysing factors associated with excessive illicit drug consumption among *all* (A3+B3+C3+D3; see Figure 6) adolescents with a history of illicit drug use. Different factors were included in the regression model in order of their potential appearance in an adolescent's life (see Table 10; Model 1-7). As seen in Table 10, model 7, variables found to be associated with excessive consumption of illicit drugs were the occurrence of mental and substance related problems in the adolescents' biological families, frequent alcohol intoxication, early age of illicit drug onset, high levels of subjective effects of substances used and future intentions to use illicit drugs.

Table 10. Hierarchical linear multiple regression. Standardized regression weights for the included variables in relation to illicit drug consumption ( $n = 371$ ).

Factors	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Gender (female)	.055	-.002	-.068	-.023	-.013	-.045	-.015
Family problems							
Mental and substance related problems <sup>a</sup>		.393***	.336***	.325***	.250**	.234**	.174*
Mental health							
Anxiety			.101	.107	.014	.045	.045
Depression			.106	.037	.002	.067	-.010
Personality							
Antagonism				.145**	.216***	.088*	.050
Impulsivity				.018	-.034	-.003	-.006
Negative affectivity				-.045	-.081	-.012	-.057
Hedonic capacity				-.113*	-.166	-.074	-.083
Alexithymia				.101	.164	.100*	.047
Substance use							
Alcohol use <sup>a</sup>					.080**	.130***	.092**
Tobacco use (daily)					.242**	.040	.049
Age of illicit drug debut						-.457***	-.393***
Positive illicit drug experiences							.288***
Negative illicit drug experiences							.089*
Intention of future illicit drug use							.088*
R <sup>2</sup>	.003	.154*	.184**	.228***	.257***	.445***	.526***

<sup>a</sup> Mean values represent an index, see *Methods* in Study 2

\*:  $p < 0,05$ ; \*\*:  $p < 0,01$ ; \*\*\*:  $p < 0,001$ . Regression diagnostics revealed collinearity between the variables depression and anxiety although the VIF and tolerance measures were acceptable.

Thus, among all factors investigated in this study, subjective effect of substance use seems to be one of the factors most strongly associated with future intentional use as well as excessive illicit drug consumption. Relations between emotional and cognitive experiences of illicit drug use and later substance use



disorders have been reported for example by Fergusson et al. (2003) and Grant et al. (2005). Increased rates of individuals' positive effects of illicit drug intake are also associated with increased rates of dependence (Zeiger et al., 2010). Individual variations in subjective effect of the substance used have found to be related to differences in functionality in specific neural systems such as the dopaminergic or endocannabinoid systems (e.g. Volkow et al., 2009; Dlugos et al., 2010).

It should be noted that some of the investigated factors in this study could be addressed as a consequence of using illicit drugs. For example, it is possible that individuals who used illicit drugs also had an increased likelihood of start to use tobacco on a regular basis and to consume alcohol in excessive amounts. In addition, occurrence of mental health problems, such as anxiety and depressive symptoms, can also be a result of substance use. Moreover, as discussed by Crews and colleagues (2007), use of substances may alter executive functions in a manner that intensifies other individual risk factors such as mental health problems. Thus, use of substances can pave the way for neuropsychological alterations and vice versa (Crews et al., 2007). Therefore, the causal relationship, at least for some of the variables investigated in this study, cannot be fully understood and it is clear that there also is a close relationship among different risk factors which simultaneously may influence the risk for illicit drug use. Despite some limitations, *Study 2* highlights intention of future drug use as well as positive drug effect of illicit drug used as possible individual risk factors that should be addressed in studies of young substance users. Intention of future drug use, in combination with other factors such as positive drug effect, can indicate an increased risk of developing misuse and dependence later on in life.

## Study 3

### Identification of cluster profiles

Three psychological factors often discussed in the literature, and evidently related to illicit drug use, are depressive symptoms, positive drug effect of illicit drug intake, and the personality trait impulsivity (e.g. Fergusson et al., 2003; Grant et al., 2005; Gullo, & Dawe, 2008; Swendsen et al., 2010). In *Study 3* the response rates of senior high school students with a history of illicit drug use were cluster analysed. Results suggest that nine statistically robust and well defined clusters of individual profiles could be identified based upon a combination of the three variables impulsivity, depressive symptoms and positive drug effect (see Figure 7). The validation procedure confirmed that the chosen solution explained significantly more of the variance than would be expected by chance.

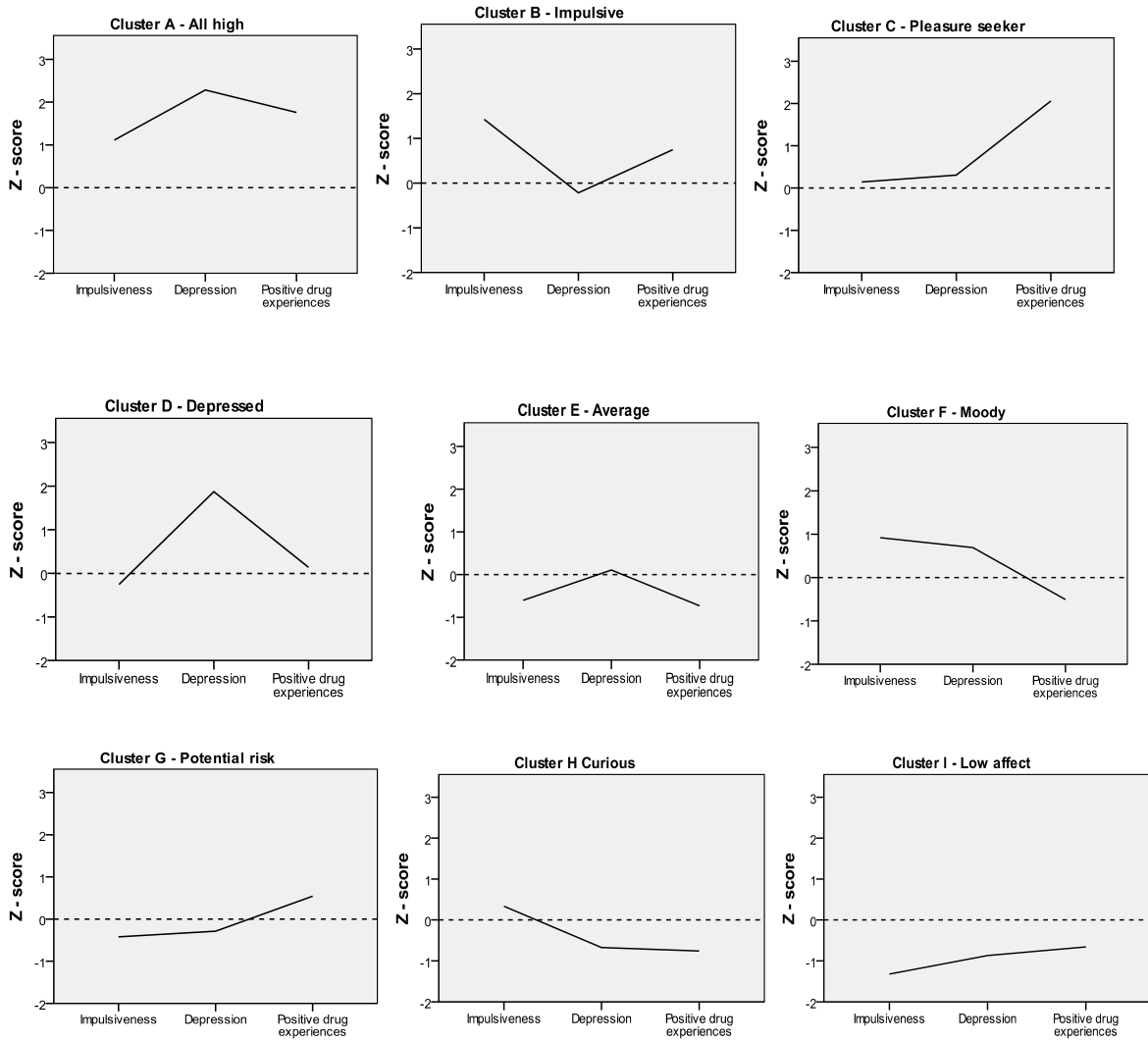


Figure 7. *Nine cluster solution. Mean value is z-transformed and one unit on the y-axis represents one standard deviation. Positive values indicate “high levels” of impulsivity, depression and positive experience of illicit drugs, and negative values indicate “low levels”.*

### Cluster profiles in relation to factors associated with substance use

The nine profiles were compared with each other by using previously known risk factors associated with substance use, such as personality traits, mental and substance related problems in the rearing family and positive attitudes towards drug use (e.g. Hawkins et al., 1992). Results demonstrate an accurate and

reliable cluster solution. The cluster profiles were further strengthened by associations found between the clusters and the other well documented risk factors for substance use included in *Study 3*. Due to the associations found between clusters and risk factors, the cluster profiles were grouped into potential high or low risk of excessive substance use.

#### *Potential high risk clusters – A, B, C and D*

Patterns of the highest levels of the cluster variables impulsivity, depressive symptoms and positive drug experiences (above 1.5 standard deviations [SD]) were reported by individuals with the profiles A, B, C and D (see Figure 7). These clusters also differed from the other five cluster profiles (i.e. E-I) with respect to several of the other known factors associated with substance use included in *Study 3*. Thus, individuals with these profiles reported the highest levels of mental and substance related problem in their biological families. The most deviant personality profiles showed the highest levels of antagonism, alexithymia and negative affectivity compared to the other potential low risk clusters. Furthermore they reported the highest levels of anxiety, the highest levels of substance use, the earliest onset of licit and illicit drug use, more positive attitudes toward drug use, and also the most frequently reported intentions to continue use illicit drugs in the future compared to the other clusters. The individuals in cluster A, with high values on all cluster variables, reported the most severe profile as regards the explanatory variables. The clusters with high values on only some of the other cluster variables were associated with other known risk variables, albeit less so than cluster A. The individuals in cluster C differed from B and D in that they report substance use at the level of cluster A coupled with the intention to use again.

Thus, adolescents in clusters A, B, C and D can therefore be considered for potentially high risk of developing problematic substance use and dependence.

#### *Potential low risk clusters – E, F, G, H and I*

Patterns of the lowest levels of the cluster variables impulsivity, depressive symptoms and positive drug effect (i.e. 0, 5 SD below mean) were reported by individuals with the cluster profiles E, F, H and I (see Figure 7). Individuals with cluster profiles E, F, G, H and I were also reporting lower levels of the other factors associated with substance use included in *Study 3*. Individuals with these profiles could thus be regarded as potentially having a lower risk for developing substance related problems and dependence.

#### Conformity of cluster profiles in a clinical sample

Cluster analyses were also performed in a clinical sample of adolescents, attending a youth clinic for substance misuse, in order to validate the cluster solutions found in the population of high school students. Result from *Study 3* showed a similar nine cluster solution in the clinical sample of adolescents. This result supports the cross-sample operational stability of the investigated variables. Comparisons were then performed between the clusters from the population of high school students with clusters from the clinical sample. Results showed no statistical differences for the clustering variable impulsivity or levels of alcohol consumption. Concerning illicit drug use, a statistical difference was only found between the A clusters.

Categorisation of factors into clusters can facilitate identification of groups of adolescents in need of specific attention in order not to develop (further) substance use problems. Adolescents in these potentially high risk clusters (see Figure 7, cluster A-D) may require tailored preventive interventions and can also be important areas of further research.

## **Limitations**

The three studies included in this thesis have all cross-sectional measurement design. Findings from cross-sectional studies can never state cause or predictions between variables. What potentially can be identified are rather associations between variables. Therefore cross-sectional studies have limited contribution to the understanding of developmental processes. As stated by Kramer and colleagues (Kreamer et al., 2000) “one must always use the result of cross-sectional studies to draw inferences about longitudinal processes with trepidation”. However, cross-sectional studies can efficiently answer many other types of research questions and results from cross-sectional studies are often the basis to identify, motivate, propose and design efficient longitudinal studies (Kreamer et al., 2000).

The statistical analysis used in the three studies reveal different associations between substance use and the other investigated variables. The analyse method used are mainly regression and cluster analyses considered to be appropriate in order to investigate the aim of the different studies. Other statistical analyses are possible in order to scrutinize the data and these analyses might reveal other potential associations between the included variables. Thus, results from studies analysing risk factors associated with substance use are to great extent influenced by considerations done by the researchers, for example what is the

aim of the study, which variables should be included and which research design should be chosen for the study. Conclusion drawn from different studies about variables relative importance and the generalisability of the findings should be done with caution.

Internal drop out and respondents with inconsequent answering patterns may have biased the results and affected the accuracies of the statistical models used in the studies. The sample in this thesis can be considered as representative for Swedish adolescents and show for example similar prevalence figures regarding substance use as other surveys performed in Sweden. However, when this type of population studies are performed research has shown that many of the adolescents with the most severe problems are not present at school and not included in the study. Finally, the true situations of the respondents are never known, only what have been reported. Data in this thesis are most certainly biased in different forms – using illicit drugs are after all illegal. These limitations are, however, not specific for the studies in this thesis but could be considered as common for other cross-sectional studies analysing factors associated with adolescent substance use.

## CONCLUSIONS

This thesis focuses on some of the significant individual oriented risk factors that previous research has shown to be relevant for adolescent substance use. The adolescents investigated in this thesis were approximately 18 years old and they were in their late adolescent period. Most of them will soon be facing one of the more turbulent transitions in a young person's life. This transition, leaving school and entering adulthood, means new challenges as well as insecurity and stress for several of them. Some of them will continue to study at university or high school, some might travel on a round-the-world trip and some will start to work, while others will face unemployment followed by severe uncertainty and pressure.

Out of the approximately 3400 students included in the thesis, 23 % reported a risk consumption of tobacco, 24 % a risk consumption of alcohol and regarding illicit drug use, 17 % reported having used illicit drugs at some point in their lives. These figures are in line with other investigations performed in Sweden (e.g. Henriksson & Leifman, 2011). Compared to other European countries, Swedish adolescents report lower prevalence rates of illicit drug use. However, use of illicit drugs, in relationship to premature death, is roughly twice as high in Sweden compared to the mean value of countries in the European Union (Olsson, 2011). Thus, the low prevalence rate of illicit drug use stands in contrast to the high mortality rate observed among those who have developed substance use disorders in Sweden. This indicates that extended and deepened knowledge about factors associated with illicit drug use is needed in order to understand the initiation of using illicit drugs as well as how problematic substance use develops.



## **Factors associated with substance use**

### Onset of substance use

One group of adolescents (approximately 300 individuals) that possibly could be considered at risk of initiating illicit drug use during the transition into adulthood were those with intention to use (see box B2, Figure 8). The individual characteristics for these adolescents were for example high levels of antagonism, high consumption of alcohol, depressive symptoms and beliefs/intention of future illicit drug use.

In the thesis, it was also found that being male was a pronounced factor. Previous studies have shown that there are no sex differences regarding the levels of illicit drug use among junior high school students in Sweden (e.g. Henriksson & Leifman, 2011), whereas slightly more male senior high school students compare to females, report illicit drug use. Moreover, it is more often males who report recent and heavy illicit drug use (Hensing, 2008). When taking a gender perspective, it does not necessarily mean focusing on the observed differences between sexes, but rather trying to understand the constructs and social norms which contribute to the idea about gender (Hensing, 2008). Thus, it is of importance to also take into account a gender perspective when discussing why some males have an increased risk of initiating substance use (see box B2, Figure 8). For example, the norm of masculinities implies that it is more acceptable for a male to use illicit drugs than for a female. Females are also seen as more sensitive and less able to handle potential adverse effects. Moreover, males face less risk of being judged by others while females becomes stigmatised more easily. In some contexts, use of illicit drugs can even be a way of expressing masculinity (Hensing, 2008). Thus to some extent, some of the

senior male high school students in the thesis can potentially be considered at risk of future illicit drug use due to gender norms.

### Moving from occasional use to frequent use of illicit drugs

The group of about 120 adolescents, who reported that they had recently used illicit drugs, and who had the intention to use again (see box C3, Figure 8), differed in two variables compared to their peers who also had used illicit drugs, but with no intention to use again (see box A3, Figure 8); positive subjective drug effect and tobacco use.

Among all factors investigated in *Study 2*, the subjective positive effect of substance use was associated with future intentional use as well as excessive drug consumption. Research regarding the rewarding potential of different substances is extensive (e.g. Volkow et al., 2009; Dlugos et al., 2010), although most of the studies are performed in laboratory settings using experimental research design. Studies that have examined subjective effect outside the laboratory, e.g. in the general populations and among adolescents are, however, relatively rare (Zeiger et al., 2010). Few, if any studies, have measured subjective effect in a population of adolescents and also concurrently controlled for the effect of other well known factors associated with substance use (as those included in *Study 2*). In contrast to laboratory studies, studies on the population offer less possibility to control for potential confounders. Awareness of several limitations are thus of importance when interpreting the results from studies measuring subjective drug effect in less controlled research design. For example, information on the subjective drug effect can be influenced if data has been collected retrospectively from individuals with different histories of use as well as different experiences of use. The impact of expectancies, respondents' mood

and mental status, the effect of possible other simultaneously used substances, as well as the dosage, can also bias responses. Despite some limitations, subjective drug effect has been found to be an important risk factor for adolescents' illicit drug use (e.g. Fergusson et al. 2003; Grant et al. 2005).

Taken together, it is possible that some of the 120 individuals in the present thesis (see box C3, Figure 8) actually are facing increased risk of future use. The awareness about the positive effects that illicit drug can induce and the potential relief it can bring, may *in itself* increase the risk of future use. This risk can be even further elevated when the adolescents meet obstacles and insecurity in the transition into adulthood.

### Factors associated with excessive substance use

Out of the total sample of 3400 senior high school students investigated in this thesis, nearly 200 adolescents could, based upon finding from previous research (e.g Hawkins et al., 1992), be considered at risk for future substance related problems. These individuals (identified in *Study 3*) were comprised of clusters (see Figure 8). Similar clusters were also found in a sample of adolescents in treatment for substance use problems.

The senior high school students with cluster profiles indicating “high risk” reported the occurrence of several well known risk factors concurrently; e.g. high levels of substance use, early onset of substance use, deviant personality traits, mental health problems, positive effect of drug use, and intention of future use as well as a heritable vulnerability. Individuals in these clusters also reported levels of substance use of magnitudes that could be considered as misuse. Furthermore, they reported a combination of personality traits, mental health problems and other risk factors to such an extent that their problems might be

classified as internal or external behavioural disorders. In this thesis, there are no data available regarding the senior high school students' involvement with health care authorities, but hopefully these adolescents (approximately 200, 18-year-olds) have been identified and receiving attention from society. If not, these young people are in urgent need of support and interventions.

**Population of senior secondary high school students (n = 3419)**

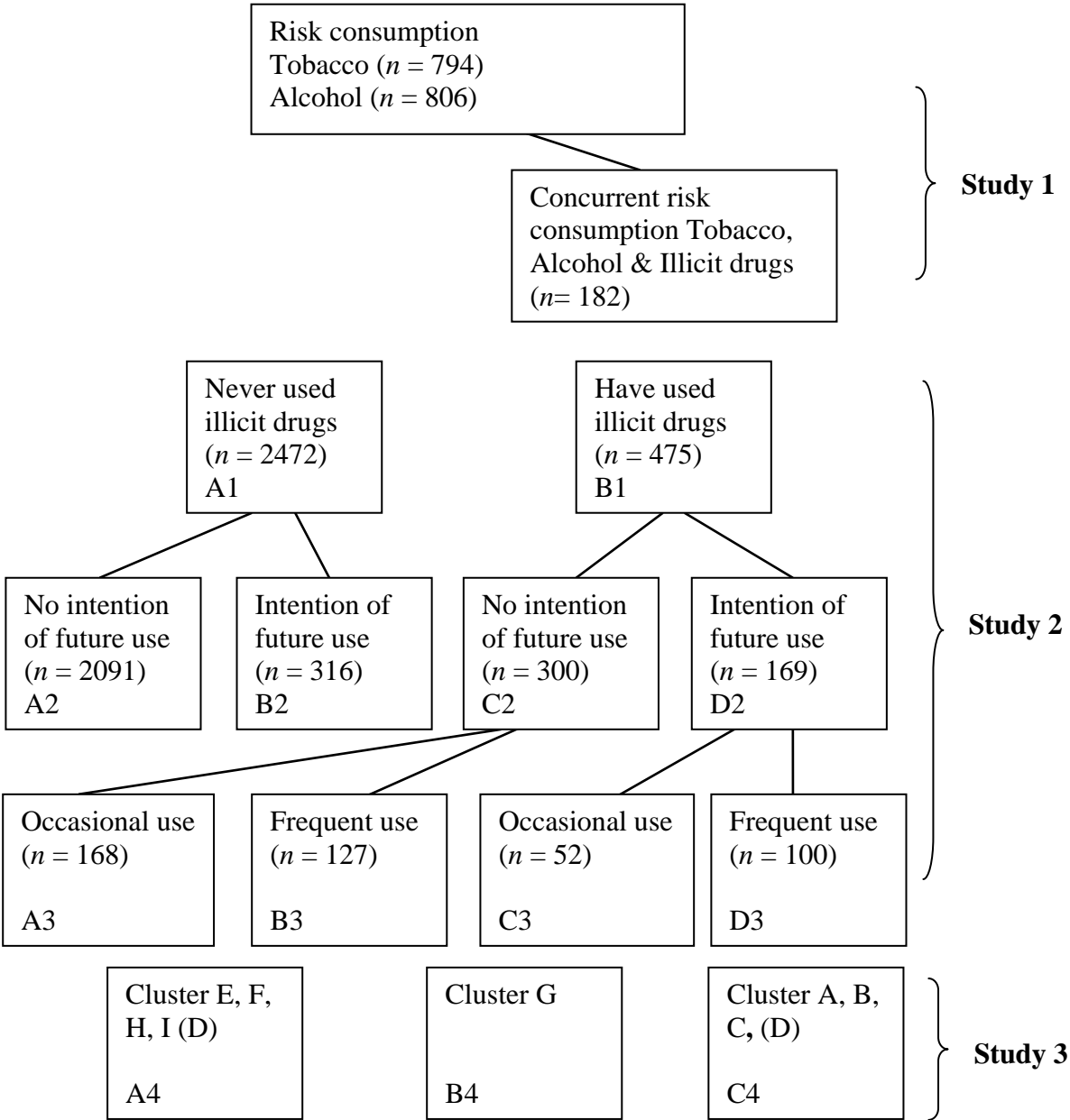


Figure 8. Overview of the different groupings of adolescents in Study 1,2 and 3 according to their intention of future use, consumption of illicit drugs and clustering variables.

## Prevention

Prevention of substance use among adolescents can be carried out in different ways, for example by targeting all individuals in a population, or aiming at specific risk groups. Prevention can also be developed to reduce the demand for drugs or the supply of them. Broadly, prevention can be categorized into three types: *universal*, *selective* and *indicative interventions*. Universal prevention focuses on the general population, with the aim of deterring or delaying the onset of substance use. Examples of universal prevention are communities' efforts to reduce the availability of and demand for substances, e.g. legalisation, subventions to police/customs and information campaigns. Selective prevention targets selected high risk groups or subsets of the general population considered to be at risk due to belonging to a particular group (e.g. children of drug users). Indicated prevention is addressing adolescents already showing early risk signs, such as the initial stages of engaging in high risk behaviour. An example of this would be adolescents who have been in contact with the authorities regarding substance use/misuse (Andréasson & Löfgren, 2008; Leifman, 2011).

Over the previous decades, the quality and effectiveness of different intervention programs has been raised. Evaluations of some frequently used intervention programs reveal a lack of evidence based methods. During the last few years, the awareness of evidence based methods has improved, and the occurrence of and use of methods that have been proven to generate a positive outcome on adolescents substance use have also increased. Treatment of substance use related problems among adolescents is often based on different forms of psychosocial interventions such as individual, group or family interventions. Programs that simultaneously target several risk factors in a young persons' life are reported to have the best effect (Jakobsson et al., 2011). Thus, this highlights

the need for awareness, among researchers as well as practitioners, that the ethology behind substance use disorders is complex.

As mentioned previously, adolescents who have used illicit drugs and experience positive drug effect can potentially be considered at risk of increased use and therefore also in need of specific attention. Furthermore, studies have found that adolescents with positive experiences from using illicit drugs, often tell peers and others about their positive experiences (Gunnarsson, Fahlke & Balldin, 2004). On the other hand, adolescents who have negative experiences from using illicit drugs more often keep these experiences to themselves and do not tell peers and others (Gunnarsson, Fahlke & Balldin, 2004). From a prevention perspective, it can be important to pay attention to this phenomenon. For example, if adolescents who have never used illicit drugs frequently hear about the positive effect, and seldom about the negative ones, it is possible that this can affect their attitudes toward illicit drugs and increase their curiosity. This phenomenon can also influence the so called majority misunderstanding, meaning that many adolescents can get the impression that the risk of negative experiences when using illicit drugs is negligible. Moreover, it should be noted that there are many illicit drug users who also experience negative effects of drug use and that the majority of them do not seek help for these problems (Gunnarsson, Fahlke & Balldin, 2004). Thus, it is important that staffs at schools, medical services and social services are aware that symptoms of psychiatric illness can in fact be drug-related symptoms.

In summary, knowledge about psychological factors associated with substance use, such as those analysed in this thesis, can thus be useful tools when it is necessary to identify individuals at risk for potential future health problems. Moreover, such knowledge can also be useful when designing other research studies as well as programs of prevention at different levels.

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