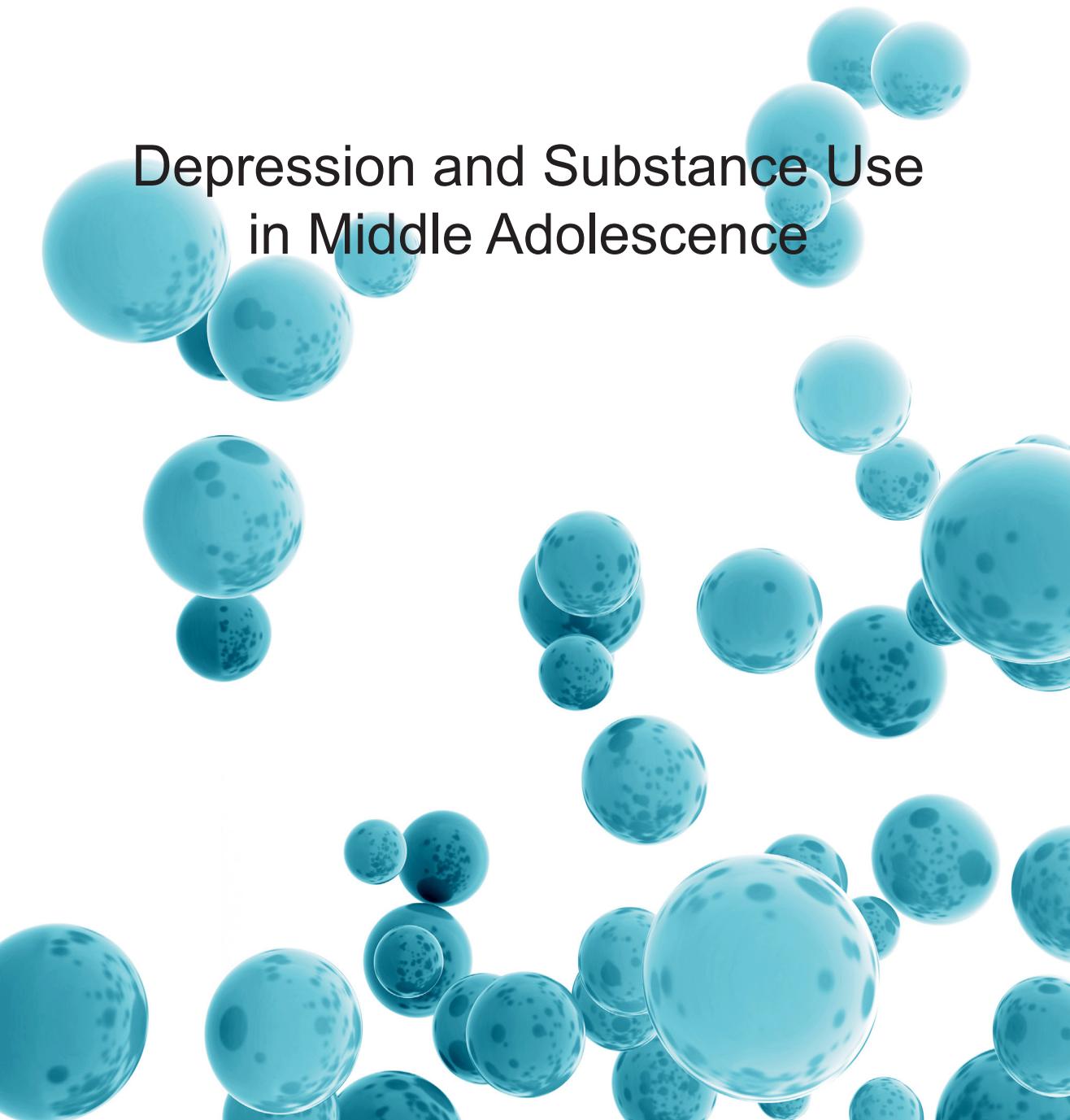


ANTTI TORIKKA

Depression and Substance Use in Middle Adolescence





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in Middle Adolescence



ACADEMIC DISSERTATION

To be presented, with the permission of
the Faculty Council of the Faculty of Medicine and Life Sciences
of the University of Tampere,
for public discussion in the auditorium F114 of the Arvo building,
Lääkärintie 1, Tampere,
on 18 August 2017, at 12 o'clock.

UNIVERSITY OF TAMPERE

ANTTI TORIKKA

Depression and Substance Use
in Middle Adolescence

Acta Universitatis Tamperensis 2290
Tampere University Press
Tampere 2017



UNIVERSITY
OF TAMPERE

ACADEMIC DISSERTATION

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Cover design by
Mikko Reinikka

Layout by
Sirpa Randell

Acta Universitatis Tamperensis 2290
ISBN 978-952-03-0469-0 (print)
ISSN-L 1455-1616
ISSN 1455-1616

Acta Electronica Universitatis Tamperensis 1793
ISBN 978-952-03-0470-6 (pdf)
ISSN 1456-954X
<http://tampub.uta.fi>

Suomen Yliopistopaino Oy – Juvenes Print
Tampere 2017



ABSTRACT

Adolescence is a challenging developmental time in life between childhood and adulthood. Adolescence is also a period involving different kinds of experiments, including experiments with substances. Rare substance use in childhood increases almost linearly from early to late adolescence. Rates of mental disorders, especially rates of depression, increase during the adolescent years and approach those of adults. Depression is among the most common mental health disorders and substance use, especially, alcohol use is common in adolescence. In general, the presence of comorbidity of substance abuse with adolescent depression has been associated with greater impairment and stress. The comorbidity of depression and substance use carries a higher risk of suicide and greater social and personal impairment as well as of other psychiatric conditions.

The aim of the present study was to investigate the associations between depression and substance use and to detect potential gender differences in the associations of depression with substance use in a large non selected middle-adolescence population. The study moreover aimed to investigate the association between substance use and suicidal ideation, which is known to be associated with depression.

The present study also examined changes in adolescent depression and alcohol use from 2000 to 2011. More specifically, it aimed to examine whether changes in depression and alcohol use over time vary according to the socio-economic background of the family in terms of parental unemployment and education and whether time trends in adolescent alcohol use differed among adolescents with and without depression.

The present study is based on the School Health Promotion Study (SHPS) conducted by the National Institute for Health and Welfare (THL), a questionnaire survey designed to examine the health, health behaviour and school experiences of Finnish teenagers conducted annually since 1995 in April among 8th and 9th graders in different Finnish regions. Studies I and II are based on the 1997 survey. The material of Studies I and II comprises the responses of pupils of the 8th and 9th grades of secondary schools (aged 14–16 years, N=17,643) in two regions of Finland (Vaasa and Tampere).

Since 2000, data collection has taken place in different regions in odd and even years so that pooled samples of consecutive years (2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009, and 2010–2011) cover the whole country. Studies III and IV are based on these pooled 2-year data time series. The number of schools participating in the survey ranged from 578 to 831 biennially. The data of the present study include those 535 schools that participated in all six of the surveys. Altogether, 618,084 (94,635–08,320 biennially) pupils were present on the survey days and returned the questionnaire in these schools.

Variables studied were: depression, alcohol use, substance use other than alcohol and sociodemographic and family background variables (age, sex, years living in the present residential area, degree of urbanization of residential area, family structure, parental education and parental unemployment). All variables were assessed with self-report questionnaires.

Univariate associations between the independent and dependent variables were analysed in each separate study by cross-tabulations with chi-square statistics and logistic regression was applied to study the multivariate associations between the variables.

The present study confirmed on population level the association of depression with frequent alcohol use and substance use other than alcohol. The association between depression and any experiment with substances other than alcohol was stronger than that between depression and frequent alcohol use or frequent drunkenness. Although there were differences in substance use patterns between girls and boys, and depression among girls was more common than among boys, there were no gender differences in associations between depression and substance use.

Frequent alcohol use, drunkenness and substance use other than alcohol indicated risk of severe suicidal ideation independently of depressive symptoms in middle adolescence, and the relationships were most pronounced with the reported use of substances other than alcohol.

Among girls, the rate of severe depression was slightly higher at the beginning of the second decade of this century (2010) than at the beginning of the first decade (2000s). Among boys no such trend was found. A novel finding of the present study is that there was a clear rising trend in depression over time among both boys and girls whose parents had a low education and who were unemployed. The major finding of the present study is that contrary to the decreasing trends in the full sample, frequent drinking and drunkenness did not decrease over time among disadvantaged, depressed adolescents. Rather, frequent drinking and drunkenness actually increased among this disadvantaged group over time.

Reducing health inequalities likely requires societal action. At the individual level, school health and welfare services and primary healthcare should develop skills and strategies to motivate and support different adolescent groups to reduce alcohol use. Targeting preventive efforts at disadvantaged adolescents and improving the living conditions of families might be useful in reducing equality gaps.

TIIVISTELMÄ

Nuoruus on nopeaa aikuiseksi kypsymisen aikaa, johon liittyy uusien asioiden kokeilua ja omaksumista. Lapsuudessa harvinainen päihteiden käyttö yleistyy keskinuoruudessa voimakkaasti. Myös mielenterveyshäiriöt kuten masennus yleistyvät nuoruudessa nopeasti ja saavuttavat aikuisuudessa esiintyvän tason. Masennus on nuorten yleisimpiä ja merkittävimpiä mielenterveyden häiriöitä. Alkoholin ja muiden päihteiden käyttö aiheuttaa terveydellisiä, myös mielenterveydellisiä ja monenlaisia sosiaalisia ongelmia, joita yhteissiintymisen masennuksen kanssa edelleen hankaloittaa. Itsetuhokäyttäytyminen, jota itsetuhoiset ajatukset edustavat lisääntyvät niin ikään nuoruudessa.

Tutkimuksen tavoitteena oli selvittää itseilmoitettujen masennusoireiden ja päihteiden käytön välisiä yhteyksiä sekä mahdollisia sukupuolieroja. Tutkimuksessa selvitettiin myös itsetuhoisten ajatusten, joiden tiedetään liittyvän masentuneisuuteen, yhteyttä päihteiden käyttöön.

Edelleen tutkittiin mahdollisia muutoksia masennuksen yleisyydessä vuodesta 2000 vuoteen 2011 sekä sitä ovatko muutokset samanlaisia eri sosioekonomistaustaisilla nuorilla.

Lopuksi tutkittiin, ovatko alkoholin käytön muutokset ajassa (trendit) samanlaisia eri sosioekonomistaustaisilla nuorilla sekä sitä vaikuttaako masentuneisuus alkoholin käytön trendeihin eri sosioekonomisten ryhmien välillä.

Tutkimusaineistona käytettiin suomalaista väestötutkimusta Kouluterveyskyselyä. Kouluterveyskysely on joka toinen vuosi vuodesta 1995 tehty valtakunnallinen poikkileikkaustutkimus nuorten terveydestä, terveystottumuksista ja koulukokemuksista. Masennuksen ja päihteiden käytön (tutkimus I) sekä itsetuhoisten ajatusten ja päihteiden käytön yhteyttä (tutkimus II) tutkittiin vuoden 1997 aineistolla, joka käsitti 17 643 14–16-vuotiasta peruskoulun kahdeksannen ja yhdeksannen luokan oppilasta.

Masennuksen ja alkoholin käytön trendejä tutkittiin niiden 535 koulun aineistossa, jotka ovat osallistuneet jokaiseen kuuteen tutkimukseen vuosien 2000 ja 2011 välillä. Kyselyn palautti kaikkiaan 618 084 oppilasta.

Alkoholin käyttö, erityisesti tiheä alkoholin käyttö ja muiden päihteiden käyttö vähäisessäkin määrin olivat yhteydessä masennukseen. Mitä enemmän päihteiden käyttöä oli sen enemmän oli myös masennusta. Huolimatta tyttöjen ja poikien päihteiden käytön eroista ja tytöillä poikia yleisemmästä masennuksen esiintymisestä masennuksen ja päihteiden käytön välisessä yhteydessä ei todettu sukupuolieroja.

Vakavien itsetuhoisten ajatusten todettiin olevan yhteydessä humalahakuiseen ja tiheään alkoholin käyttöön. Vakavat itsetuhoiset ajatukset olivat myös itsenäisesti masennuksesta riippumatta yhteydessä muiden päihteiden kuin alkoholin käyttöön.

Tytöt raportoivat masennusta jonkin verran enemmän tutkimuksen lopussa (2010–2011) kuin tutkimuksen alussa (2000–2001). Pojilla vastaavaa trendiä ei havaittu. Merkittävä tulos oli, että niillä nuorilla sekä tytöillä että pojilla, joiden vanhemmat olivat vähän kouluttautuneita ja työttömiä, jo ennestään yleinen masennus edelleen lisääntyi.

Tiheä käyttö ja humalahakuinen juominen vähenivät tutkimusjakson aikana. Vastoin yleistä alkoholin käytön vähenemistä tiheä juominen ja humalajuominen sen sijaan lisääntyivät niillä nuorilla, jotka olivat vähän koulutettujen, työttömänä olleiden vanhempien perheistä ja joilla oli masennusta.

Tutkimuksen tulokset tukevat tarvetta pyrkiä nuorten alkoholin käytön edelleen vähentämiseen sekä ennen kaikkea terveyserojen kaventamiseen kohdentamalla terveys- ja hyvinvointipalveluja etenkin huono-osaisimpiin nuoriin ja heidän perheisiinsä.

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LIST OF ORIGINAL PUBLICATIONS

This dissertation is based on the following original publications, which are referred to in the text by the Roman numerals I–IV.

- I Torikka A, Kaltiala-Heino R, Rimpelä A, Rimpelä M and Rantanen P (2001): Depression, drinking and substance use among 14- to 16-year old Finnish adolescents. *Nord J Psychiatry* 55:351-357.
- II Torikka A, Kaltiala-Heino R, Marttunen M, Rimpelä A, Rantanen P and Rimpelä M (2002): Drinking, other substance use and suicidal ideation in middle adolescence: a population study. *J Substance Use* 7:237-244.
- III Torikka A, Kaltiala-Heino R, Rimpelä A, Marttunen M, Luukkaala T and Rimpelä M (2014): Self-reported depression is increasing among socio-economically disadvantaged adolescents-repeated cross-sectional surveys from Finland from 2000 to 2011. *BMC Public Health* 14:408. doi:10.1186/1471-2458-14-408.
- IV Torikka A, Kaltiala-Heino R, Luukkaala T and Rimpelä A (2017): Trends in Alcohol Use among Adolescents from 2000 to 2011: The Role of Socioeconomic Status and Depression. *Alcohol Alcohol* 52(1):95-103.

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ABBREVIATIONS

AACAP	American Academy of Child & Adolescent Psychiatry
APA	American Psychiatric Association
AUD	Alcohol Use Disorder
BDI	Beck Depression Inventory
CDI	Children's Depression Inventory
CES-DC	Center for Epidemiological Studies-Depression Scale for Children
CI	Confidence Interval
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, fourth edition
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, fifth edition
ECA	Epidemiological Catchment Area Study
ESPAD	European School Survey Project on Alcohol and Other Drugs
HRS-D	Hamilton Rating Scale for Depression
ICD-10	International Classification of Diseases, tenth edition
IQ	Intelligence quotient
K-SADS	Schedule for Affective Disorders and Schizophrenia for School Aged Children (6–18 years)
MDD	Major Depressive Disorder
NCS-A	National Comorbidity Surveys-Adolescent Supplement
OR	Odds Ratio
RADS	Reynolds Adolescent Depression Scale
RBDI	the Finnish modification of the 13-item Beck Depression Inventory
SES	Socio-economic status
SHPS	the School Health Promotion Study
SUD	Substance Use Disorder
THL	Terveyden ja Hyvinvoinnin Laitos (the National Institute for Health and Welfare)

1 INTRODUCTION

The number of abstainers has increased and the formerly highly prevalent episodic drinking among Finnish adolescents decreased in the 2000s (Raitasalo et al. 2015).

The Finnish Government proposed amendments to the Alcohol Act (Sosiaali- ja terveystieteiden ministeriö 2016). According to the amendments retailers, kiosks and petrol stations are allowed to sell stronger beers, ciders and alcohol blends than before. If the amendments are realized the positive trend in alcohol consumption seen in recent years may be compromised. Alcohol will become more readily available and most likely the prices of alcoholic beverages will fall due to special offers and the risk of rising alcohol consumption will increase. This may lead to increased parental alcohol use, which in turn adversely affects the well-being of children. The price and availability of alcohol also have a major impact on underage drinking. Social exclusion due to alcohol consumption will likely increase and health inequalities will grow.

Four-fifths of young people's incapacity for work are caused by mental disorders, mood disorders being the most common. Among Finns aged 16–39 some 24,000 have a disability pension due to mental disorders. Contrary to the general decreasing trend, the number of retirements due to disability has increased in recent years among those aged 16 to 39 (KELA 2016).

Depression in children and adolescents imposes significant burdens on individuals and public health systems (Kapornai and Vetro 2008). Depression in adolescence is often unrecognised and undertreated (Leaf et al. 1996, Aalto-Setälä et al. 2002, Avenevoli et al. 2015). Early onset depressions are frequent, recurrent and familial disorders that tend to continue into adulthood, frequently accompanied by other psychiatric disorders. (Karlsson et al. 2006, Marttunen and Karlsson 2010.)

Age trends suggest that substance use is a developmental phenomenon, which increases almost linearly from early to late adolescence, and alcohol is the most commonly abused substance (Young et al. 2002). Alcohol use and misuse occur on a continuum and associated problems may occur long before actual dependence (Rohde et al. 1996). Associations have been established between adolescent involvement with alcohol and a range of adverse consequences, including educational problems (Ellickson et al. 2003, Kuntsche et al. 2013), future drinking and drug use (Hingson et al. 2006, Windle et al. 2009), unplanned and risky sex, motor vehicle crashes, and various physical and emotional problems (Simons-Morton et al. 2009). Further substance use is associated with the chronic course of major depressive disorder among adolescents (Essau 2007).

Substance use is associated with suicidal ideation and attempts among adolescents (Wong et al. 2013) and may facilitate the transition from suicidal ideation to suicidal behaviour (Bridge et al. 2006).

The association between depression and suicidal ideation, and the association between substance use and suicidal ideation are documented. However, research on whether alcohol use and substance use other than alcohol are independently associated with suicidal ideation in a large representative middle adolescent population is still needed.

A problem in many previous time trend studies on adolescent depression is that they have not used comparable samples or comparable measurement instruments. In addition, earlier studies on time trends in adolescent depression have not considered the possibility that changes in the prevalence of depression among adolescents may vary across population groups. Therefore research examining time trends in adolescent depression according to the socio-economic background of the family (parental unemployment and education) using the same measurement instrument and the same collection method throughout the study is badly needed.

Frequent alcohol consumption and drunkenness have decreased among Finnish adolescents since the beginning of the 2000s and the same downward trend has been observed in many other western countries in the 2000s. However, contradictory findings have been reported regarding the association between socio-economic status (SES) and adolescent alcohol use. Thus research exploring whether trends in adolescent alcohol use differed over time among different socio-economic groups is needed. Furthermore, no adolescent alcohol use time trend studies have accounted for the role of depression.

In order to better target resources and improve health services more information is needed on trends in mental health disorders. Therefore it is important to examine if the time trends in adolescent alcohol use and drunkenness are similar in different socio-economic groups, and whether depression plays a role in differentiating trend in alcohol use between groups.

2 REVIEW OF THE LITERATURE

2.1 Adolescent development

Terms referring to adolescence have been around since the 15th century to describe the period of growing to maturity, but the concept of adolescence as a special phase of life, different from both childhood and adulthood, has only been seriously examined in the last 100 years (Costello et al. 2011, Dahl and Hariri 2005). Adolescence is a transitional life period between childhood and adulthood. It begins at puberty around age 12 or 13 years and ends usually around age 21 or 22 when gradual shift to young adulthood takes place. The physical changes that signal onset of adolescence occur alongside psychological and social changes that mark this period as a critical stage in becoming an adult (Christie and Viner 2005). The primary challenges of adolescence are the achievement of biological and sexual maturation, the development of personal identity, the development of intimate sexual relationships with appropriate peer and establishment of independence and autonomy in the context of the socio-cultural environment. Girls enter puberty before boys. Girls also seem to develop considerably earlier as the female growth spurt occurs early in puberty (mean age 11–12 years) compared with that in boys (mean age 14 years). There is great variation between individuals in speed of maturation. The change from prepuberty to full reproductive capacity may take from 18 months to five years. At age 13 boys may manifest the entire range. The mean age of menarche showed a substantial decline in most developed countries throughout the first half of the 20th century stabilising in the 1960s in most countries at around 13 years (Christie and Viner 2005). Adolescence is divided into three developmental phases entailing early adolescence (ages 10–13), middle adolescence (ages 14–17) and late adolescence (from 18 until early twenties). In early adolescence the main challenges are: adaptation to bodily changes, initiation of emotional separation from parents and beginning of marked identification with peers. In addition to the above mentioned challenges abstract and moral thinking develop, verbal abilities grow, emotional separation from parents continues in middle adolescence. Middle adolescence is a period of increasing health risk behaviours. In middle adolescence biological changes are usually complete for females, whereas males mature more slowly and are in mid-puberty. In late adolescence the main tasks are development of social autonomy and personal identity (Christie and Viner 2005). Research findings suggest that adolescence should not be characterized as a time of severe emotional upheaval and turmoil because the majority (80%) of adolescents manage

this transition quite well. Nevertheless a sizeable proportion of young people (20%) do not fare so well, with many not receiving the help they may need (Offer and Schonert-Reichl 1992).

Clinicians have viewed puberty as a point of maturing out of childhood-onset conditions. On the other hand it marks a transition in risks for depression and other mental disorders, psychosomatic syndromes, substance misuse and antisocial behaviours (Patton and Viner 2007).

2.2 Adolescent depression

2.2.1 Depression and depressive symptoms

Depression is a common cause of disability, associated with a substantial impairment in quality of life (Sobocki et al. 2007). Depression in children and adolescents imposes significant burdens on individuals and public health systems (Kapornai and Vetro 2008). Adolescent depression is a major risk factor for suicide (Marttunen et al. 1991, Windfuhr et al. 2008). Depression in adolescence often goes unrecognised and hence is undertreated (Leaf et al. 1996, Aalto-Setälä et al. 2002, Avenevoli et al. 2015). According to Thapar et al. (2012) the possible reasons for failure to diagnose depression are the prominence of irritability, mood reactivity and fluctuating symptoms in adolescents. Depression may also be missed if the primary reported features are behavioural problems, substance abuse, anxiety problems, refusal to go school, poor school performance or unexplained physical symptoms (Thapar et al. 2010).

Increasing levels of depressive symptoms among adolescents are associated with increasing levels of psychosocial dysfunction and incidence of major depression and substance use disorders (Lewinsohn et al. 2000). This suggests that (a) the clinical significance of depressive symptoms does not depend on crossing the major depressive diagnostic threshold and (b) depression may best be conceptualized as a continuum. Symptom related impairment is common even below the threshold of diagnosing clinical depressive disorder (Pickles et al. 2001). Measures of major depression are best described by a dimensional model in which the severity of symptoms ranges from none to severe (Fergusson et al. 2005, Hankin et al. 2005). According to this model, those meeting diagnostic criteria for MD represent the extreme of a continuum rather than a distinct group of individuals suffering from a specific disorder. The risk for escalation of subthreshold depressive disorder to full-syndrome depressive disorders has been suggested to be as high as 67% (Klein et al. 2009).

2.2.2 Measurement of depression

The structure of depression observed in adolescents is very similar to that observed in adults (Lamers et al. 2012). Depression is defined as a cluster of specific symptoms with associated impairment and the clinical and diagnostic features of the disorder are largely similar in adolescents and adults (Thapar et al. 2012). Impairment means reduced functioning in one or more major domains of life (academic performance, family relationships, and peer interactions (AACAP 2007). The two main classification systems: the international classification of diseases (ICD-10) and the American Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5), do not greatly differ from each other. In the DSM-5 irritable rather than depressed mood is specified as a core diagnostic symptom in children and adolescents. The DSM-5 requires for diagnosis of Major Depressive Disorder five of the nine defined symptoms to be present during the same two-week period. Of the symptoms, (1) depressed mood, which in children and adolescents, may be irritable mood or (2) loss of interest or pleasure are key criteria and one of these must be present. The other possible symptoms are: significant weight loss when not dieting or weight gain, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness, diminished ability to think or concentrate and recurrent thoughts of death (APA 2013). Symptoms may not be solely attributable to substance abuse, medications taken, other psychiatric illness, bereavement or medical illness (AACAP 2007). A formal diagnosis of depression can be made by assessing the diagnostic criteria in an interview, in either an unstructured clinical interview or by using structured diagnostic assessment tools such as K-SADS (Ambrosini 2000). In scientific research, structured diagnostic interviews are the most reliable method for diagnosing depression, but they are time-consuming, require specially trained interviewers and are difficult to apply in large population studies.

Depression screening measures (symptom self-reports) do not diagnose depression, because they do not address important diagnostic features such as duration of symptoms, degree of impairment and comorbid psychiatric disorders, but they provide an indication of the severity of symptoms within a given period of time (e.g., the past 14 days). All measures have a statistically predetermined cut-off score at which depression symptoms are considered significant and higher scores consistently reflect more severe symptoms (Sharp and Lipsky 2002).

The most often used depression rating scale used with adolescents is the Beck Depression Inventory (BDI) (Myers and Winters 2002) (described in more detail in Chapter 4: Materials and Methods). In addition the following rating scales are widely used in adolescent depression screening: Children's Depression Inventory (CDI), Center for Epidemiological Studies – Depression Scale for Children (CES-DC), the Reynolds Adolescent Depression Scale (RADSD) and the Hamilton Rating Scale for Depression (HRSD) (Myers and Winters 2002).

The discrepancy between the high prevalence of symptoms in screening scales and the comparatively low prevalence of depressive disorders means that many people have

subsyndromal depressive symptoms (Kessler and Wong 2009). Population surveys provide information on those adolescents whom the public health care system does not reach. A shortcoming of these studies is the fact that not all respond and specifically the non-responders may suffer from problems more often than responders (Kaltiala-Heino et al. 2015, Kekkonen 2016).

2.2.3 Prevalence of adolescent depression

Epidemiologic studies show that major depression is comparatively rare among children, but common among adolescents, with up to 25% lifetime prevalence by the end of adolescence (Kessler et al. 2001). The peak increase in both overall rates of depression and new cases of depression occur between the ages of 15 and 18 (Hankin et al. 1998).

According to AACAP (2007) the prevalence of major depressive disorder is estimated to be approximately 2% in children and 4% to 8% in adolescents. Further approximately 5% to 10% of children and adolescents have subsyndromal symptoms of MDD. One estimated one-year prevalence of unipolar depression is 4–5% (Costello et al. 2005, Costello et al. 2006). According to Merikangas et al. (2010) the overall prevalence of mood disorders was 14.3% and the prevalence with severe impairment was 11.2% in adolescents in the USA. According to the study by Avenevoli et al. (2015) based on data from the National Comorbidity Surveys – Adolescent Supplement (NCS-A), a nationally representative survey of adolescents aged 13 to 18 years, lifetime and 12-month prevalence of MDD were 11.0% and 7.5% respectively. The corresponding rates of severe MDD were 3.0% and 2.3%. The prevalence of MDD increased significantly across adolescence, with markedly greater increases among females than among males. The prevalence of severe MDD was about one-fourth of that of all MDD cases. The variability in the estimate of the number of adolescents suffering from depression can be attributed to (a) use of different diagnostic criteria (e.g., DSM criteria, K-SADS); (b) differing definitions of adolescent depression (e.g., as a mood, symptom or clinical diagnosis); (c) the use of different assessment measures (e.g., self-report, structured interviews, multiple sources of information other than the adolescent); or (d) the use of heterogeneous samples (clinical versus community) (Galaif et al. 2007).

In childhood depression is equally common among both sexes (Hyde et al. 2008), but in adolescence twice as many girls as boys are depressed (Reinherz et al. 2000, Fröjd et al. 2006). The mechanisms underlying this change in prevalence remain unclear. However, it may reflect the interplay of gender socialisation, social and hormonal mechanisms and stressful events associated with adolescence (Cyranowski et al. 2000, Essau et al. 2010). Hyde et al. (2008) account for the gender difference by a model that integrates affective, biological and cognitive factors as vulnerabilities to depression which, in interaction with negative life events, exacerbate girls' rates of depression beginning in adolescence and thus account for the gender difference in depression.

2.2.4 Comorbidity in adolescent depression

Comorbidity, the occurrence of two or more disorders at the same time, seems to be rather a rule than an exception in adolescent major depression. It has been suggested that nearly 60% of depressed adolescents in a community setting had at least one additional disorder. The most common pattern is that of depressive and anxiety disorders, various phobias being the most common anxiety disorders (Essau 2008). Depressive disorders usually manifest after the onset of other psychiatric disorders (e.g. anxiety), but depression also increases the risk for developing non-mood psychiatric problems such as conduct and substance abuse disorders (AACAP 2007). Patterns of comorbidity generally do not differ by sex, with the exception that girls with MDD are at greater risk for anxiety or ADHD compared to their male counterparts. Any disorder shows a significantly stronger association with severe than with mild/ moderate MDD. Somatic complaints are often associated with depression (Egger et al. 1999).

2.2.5 Course and outcome

Up to 90% of adolescents with depression recover from a single episode within two years (Birmaher et al. 1996, Marttunen and Karlsson 2010). Reported rates of one-year recovery vary widely, between 40% and 90% (Emslie et al. 1997, Birmaher et al. 2002, Karlsson et al. 2008, Marttunen and Karlsson 2010). The reportedly large variation is at least partially due to varying definitions of recovery and other methodological issues (Marttunen and Karlsson 2010). Adolescent depression is often recurrent and is associated with a range of adverse outcomes including social and educational impairments as well as both physical and other mental health problems later in life (Bardone et al. 1998, Thapar et al. 2012, Maughan et al. 2013). Psychosocial impairment tends to be more severe in depressed adolescents with comorbid disorders than in those without (Lewinsohn et al. 1995). Early onset depressions are frequent, recurrent and familial disorders that tend to persist into adulthood, and they are frequently accompanied by other psychiatric disorders (Lewinsohn et al. 1994, Essau et al. 2010). Residual symptoms are prevalent after an episode and constitute a substantial risk for relapse into depression (Fava et al. 2007, Conradi et al. 2011). Adolescents with subthreshold depression are a group at elevated risk of later depression, suicidal ideation and suicide attempts (Fergusson et al. 2005). It has been suggested that at least 50% of adolescents with major depression suffer relapses as adults (Kessler et al. 2001).

2.2.6 Individual, familial and socio-demographic correlates

All sources of personal stress are related to adolescent depression (Low et al. 2012). Stressful life events, lack of social support, problems with peers, family problems and intra-

individual vulnerabilities such as subthreshold depressive symptoms all increase the risk of major depressive episode in adolescence. (Rubin et al. 1992, Steinhausen et al. 2000, Avison and Mcalpine 1992, Low et al. 2012, Väänänen et al. 2014, Hill et al. 2014.) Rubin et al. (1992) suggested that lack of social support from peers is a greater risk for depression in boys, and lack of support from the family for girls. Adolescents who are bullied and those who are bullies are at an increased risk of depression (Kaltiala-Heino et al. 1999a).

It is known that depression is related to socio-economic circumstances. Low family income and socio-economic status (Piko and Fitzpatrick 2007, Lemstra et al. 2008, Tracy et al. 2008), as well as exposure to poverty in the early stages of life are known risk factors for adolescent depression (Najman et al. 2010). The material factors affect health mainly through the mediating factors that are linked to an uneven distribution of the available financial resources (Laaksonen 2011). It is suggested that limited material resources in a family predict impaired health-related quality of life especially in adolescence, whereas level of parental education has a more marked effect on psychological wellbeing, moods, and emotions in childhood (von Rueden et al. 2006). Mother's educational level plays the most important role in (positively) influencing adolescents' psychosocial health, and lower level of mother's education is related to depressive symptoms (Piko and Fitzpatrick 2007).

Having a parent with a history of major depression is one of the strongest predictors of depression in the offspring's adolescence (Hankin 2006). Behaviour genetic studies on children and adolescents have found depression to be moderately heritable (Sullivan et al. 2000, Rice et al. 2002, Hankin 2006). Adolescents with parents with a (lifetime) depressive disorder are more sensitive to the depressogenic effects of stressful events than adolescents whose parents are not depressed (Bouma et al. 2008).

2.2.7 Trends over time in adolescent depression

The findings on the trends in adolescent depression are inconsistent. A meta-analysis by Costello et al. (2006) and a review by Richter et al. (2008) suggest that there has been no evidence of an increase in depressive disorders over the past 30 years. Some older studies (Birmaher et al. 1996, Fombonne 1998a), however, suggest an increase in prevalence and a decrease in age at the onset of depression. This has been particularly evident in those studies extending to the mid-2000s. In Iceland depressive symptoms increased significantly among girls from 1997 to 2006 and the proportion of adolescents attending mental health services also increased (Sigfusdottir et al. 2008). In the UK twice as many adolescents reported frequent feelings of depression in 2006 than in 1986 (Collishaw et al. 2010). According to a Finnish study (Sourander et al. 2008) depressive symptoms increased among 8-year-old girls from 1989 to 2005.

2.3 Substance use in adolescence

2.3.1 Characteristics of substance use

Adolescence is a period of different kinds of experimentations, including experiments with substances. Substance use seems to be a developmental phenomenon, which increases almost linearly from early to late adolescence (Young et al. 2002). Although substance use disorders are less common than experimentation in adolescence (Young et al. 2002), associated problems may occur long before actual dependence (Rohde et al. 1996).

Alcohol is the intoxicant of choice for youth in Europe and in the United States (Faden 2006, Hibell et al. 2012). Among 12-year-olds substance use is not yet part of their everyday lives, and alcohol use is rare in this age group (Kinnunen et al. 2015). By the age of 16 years, 90% of teenagers have experimented with alcohol (Fombonne 1998a, Hibell et al. 2012) and prevalence of drunkenness and weekly drinking increases significantly between ages 11 and 15 for boys and girls (Currie et al. 2012).

Cannabis is the most consumed drug among adolescents (Rubino et al. 2012). Compared with the European average, fewer Finnish adolescents (15–16 year-olds) report life time use of cannabis and of illicit drugs other than cannabis, while lifetime use of inhalants and non-specific use of sedatives and tranquillisers are of the same magnitude as the European average (Hibell et al. 2012).

2.3.2 Frequent alcohol use and drunkenness: nature and assessment

According to the International Classification of Diseases (ICD-10) alcohol or other substance use dependence refers to a severe and persistent pattern of alcohol or other substance use which results in psychosocial or medical impairment. Substance dependence (e.g. alcohol) syndrome is a cluster of behavioural, cognitive and physiological phenomena that develop after repeated substance use and that typically include a strong desire to take the drug, difficulties in controlling its use, persisting in its use despite harmful consequences, a higher priority given to drug use than to other activities and obligations, increased tolerance and sometimes a state of physical withdrawal. Harmful use is a pattern of psychoactive substance use that is deleterious to health. The damage may be physiological or mental (Terveyden ja hyvinvoinnin laitos 2011).

According to the study by Ilomäki et al. (2008) as many as 41 %/40% of psychiatric inpatient boys/girls also had alcohol use disorder, and 31%/13% had drug use disorder. General population adolescents usually do not yet have substance use disorders fulfilling the diagnostic criteria of dependence. Therefore it is reasonable for researchers to focus on substance use patterns (Kaltiala-Heino et al. 2015). National surveys examining prevalence rates for alcohol use and misuse among adolescents tend to describe experimentation with alcohol in terms of any lifetime or current drinking and rates of binge drinking rather

than in terms of diagnostic criteria. Among young people, a high reported number of binge drinking episodes is considered a marker for dangerous or hazardous use (Schulte et al. 2009). Alcohol intoxication is an outcome of excessive alcohol intake (Paljärvi 2014). Binge drinking occasions typically lead to alcohol intoxication, as 'getting drunk' is often the main motivation for drinking among persons engaging in binge drinking (Wechsler et al. 1994, Paljärvi 2014). Binge drinking is the practice of consuming large quantities of alcohol in a single session, usually defined as five or more drinks at one time for a man, or four or more drinks at one time for a woman. Adolescent alcohol consumption takes the form of binge drinking (Foundation For a Drug-Free World 2015). Binge drinking is a particularly important measure in assessing alcohol use because its consequence – almost invariably intoxication – carries specific health and psychological risks that may not occur with a single, occasional drink. Thus, "binge drinking" is an important measure of the intensity of alcohol use, although it does not necessarily translate into alcohol abuse or alcohol dependence (Deas and Clark 2009).

Another valid method to study adolescents' harmful alcohol consumption is to elicit adolescents' experiences of being drunk. Subjective drunkenness experiences can be measured by asking if an adolescent has ever drunk so much alcohol as to be really drunk and how often this has happened. Self-reported drunkenness relates logically to amounts of alcohol consumed in adolescence (Lintonen et al. 2004). Given that underage adolescents may not consume alcohol as restaurant drinks of fixed amounts, measuring experiences of being drunk may be an even more suitable method to study adolescents' harmful drinking than eliciting the number of drinks consumed at one session.

Since the sale of alcohol to minors is prohibited by law and as efforts are made to restrict underage alcohol consumption in Finland, it is relevant to measure even small amounts of alcohol that adolescents have consumed. Even small amounts used continuously can be harmful.

2.3.3 Prevalence and trends in adolescent substance use

Substance use becomes increasingly common during adolescence (Cerdá et al. 2013). Substance use disorders are less common than experimentation in adolescence (Young et al. 2002). Age trends suggest that substance use is a developmental phenomenon, which increases almost linearly from early to late adolescence, and alcohol is the most commonly substance abused (Young et al. 2002). Polydrug use is an increasingly common phenomenon among European young people (European Monitoring Centre for Drug Addiction 2009). Merikangas and her colleagues (2010), who studied lifetime prevalence of mental disorders in adolescents in the USA reported an 11.4% prevalence of substance use disorders.

Prevalence of alcohol use increases during adolescence (Lintonen et al. 2013 and it has been suggested that the peak years for initiation of alcohol use are ages 13 and 14 (Faden 2006).

Wide variation has been reported in experimentation with or actual consumption of alcohol in different countries (Hibell et al. 2012). Although alcohol use among Finnish 15–16 year olds is not more common than in Europe on average, Finnish adolescents report consuming alcohol in larger quantities than their European peers (Hibell et al. 2012).

Trends in alcohol use and drunkenness vary by country. Adolescent alcohol use and drunkenness have shown a decreasing trend in the 2000's in the USA (Keyes and Miech 2013, Gruzca et al. 2009), in Canada (Elgar et al. 2011), in the UK (Healey et al. 2014), in Germany (Lambert and Kunzt 2014), in New Zealand (Clark et al. 2013) and in Finland (Sourander et al. 2012, Raitasalo et al. 2015, Hibell et al. 2012). Contrary to these findings, alcohol consumption has not decreased (de Looze et al. 2014), but actually increased in the Netherlands (Geels et al. 2012). Moreover, no clear trend in the rate of risky drinking was found (Livingston 2008), but abstention increased significantly among Australian adolescents (Livingston 2014).

In general drinking and drunkenness are more common among boys than among girls (Simons-Morton et al. 2009, Lambert and Kuntz 2014, Raitasalo et al. 2015). Average monthly alcohol consumption and lifetime drunkenness among 15-year-olds have declined in 20 European countries, in the Russian Federation, Israel, the USA and Canada from 1998 to 2006 and the overall decline was greater among boys than among girls. In most countries where drinking or drunkenness increased, this was mainly due to increases among girls (Simons-Morton et al. 2009). The price of alcohol products has risen due to tax increases in recent years, and at the same time total alcohol consumption has decreased in Finland (Terveyden ja hyvinvoinnin laitos 2017). Obtaining alcohol has become more difficult due to stricter control of sales of alcohol to minors in Finland (Lintonen et al. 2013).

According to the European School Survey Project on Alcohol and Other Drugs (ESPAD) (Raitasalo et al. 2015), a survey conducted among 16-year-olds every four year since 1995 in 23–26 countries and most recently in 36 countries the number of abstainers among adolescents increased from one tenth in 1999 to as much as 26% in Finland in 2015. The extremely prevalent heavy episodic drinking among adolescents in Finland in the late 1990s decreased significantly as did alcohol use in general during the 2000s. The decline was particularly marked from 2011 to the latest measurement in 2015. However, 37% of adolescents aged 15–16 years still reported being drunk at least once in their lives and about 7% reported getting drunk approximately every week. The proportion of adolescents drinking alcohol at least once a week has declined from 21% (boys 24%, girls 20%) in 1999 to nine percent (boys 10%, girls 8%) in 2015. At the same time the proportion of adolescents who reported drinking weekly or more often at least six drinks in a single drinking session had declined from 18% (boys 21%, girls 15%) in 1999 to seven percent (boys 8%, girls 6%) in 2015 (Raitasalo et al. 2015). The differences between boys' and girls' alcohol use have decreased. Further according to the ESPAD study (ESPAD Group 2016) Finnish adolescents reported less alcohol use (32%/48%) and heavy episodic

drinking (23%/35%) during the past 30 days than the European adolescents on the average in 2015. In the Nordic countries alcohol use and drunkenness are most common among Danish adolescents, followed by Finnish, Swedish, Norwegian and Icelandic adolescents in that order. Experimentations with alcohol nowadays begins at an older age than earlier and the age of onset of drinking to intoxication has risen in recent years (Raitasalo et al. 2015). At the same time attitudes among adolescents have become stricter regarding weekly drinking to intoxication. Parents' attitudes towards underage alcohol use also have become more negative than earlier (Raitasalo and Holmila 2014).

The use of cannabis has increased among young adults in Finland in recent years. In contrast, there has been no notable change in cannabis use among 15–16-year-olds (Raitasalo et al. 2015). In 2015, 10% of boys and 7% of girls had used cannabis in their lifetime. The use of other illegal drugs is rare among 15–16-year-olds. In 2015, 3% of adolescents reported having tried some other drug than cannabis. The use of tranquillizers or sedatives without prescription, more prevalent among girls, has somewhat decreased among both boys and girls. In 2015, 4% of boys and 8% of girls reported having used these drugs. The proportion of adolescents who had taken alcohol together with pills has decreased from 1995. In 2015, 3% of boys and 7% of girls had used alcohol together with pills during their life time. The trend for inhalant use is decreasing. In 2015, 7% of boys and 8% of girls reported having tried these substances during their life time (Raitasalo et al. 2015).

2.3.4 Comorbidity in substance use

Comorbidity between mental and substance use disorders is highly prevalent across countries. Substance use problems in adolescents also tend to co-occur with other psychiatric conditions, and approximately 75% of adolescents with current alcohol and/or drug use disorders also meet the criteria for mood, anxiety or conduct disorders (Kandel et al. 1999). In general people with a substance use disorder have higher comorbid rates of mental disorders than vice versa, and conversely people with illicit drug use disorders have the highest rates of comorbid conduct, mood and anxiety disorders. There is a strong direct association between the magnitude of comorbidity and the severity of substance use disorders (Jane-Llopis and Matytsina 2006). Adolescents reporting more comorbidity are likely to engage in substance use more frequently (White et al. 2015). While causal pathways differ across substance use disorders, there is evidence that alcohol is a causal factor for depression (Jane-Llopis and Matytsina 2006). In the Oregon Adolescence Depression Project increased alcohol use was associated with increased lifetime occurrence of other substance use, conduct and depressive disorders. Co-occurrence appeared to be dose related. Of the problem drinkers, 39% were estimated to be depressive. On the other hand, 23% of adolescents with major depressive disorder in the community also had substance use disorder (Rohde et al. 1996, Lewinsohn et al. 1995).

2.3.5 Course and consequences of substance use

Adolescent alcohol use is a considerable public health problem. Associations have been established between adolescent alcohol involvement and range of adverse consequences, including academic problems (Ellickson et al. 2003, Latvala et al. 2014), future drinking and drug use (Hingson et al. 2006), risky sex, motor vehicle crashes, various physical and emotional problems (Simons-Morton et al. 2009), frequent truancy and involvement in delinquent behaviours (Best et al. 2006).

Alcohol use and misuse occur on a continuum and associated problems may occur long before actual dependence (Rohde et al. 1996). Early onset of drinking correlates with the frequency of any drinking and the frequency of binge drinking for boys and girls similarly in middle adolescence (Morean et al. 2014) and is associated with later problems with alcohol, including dependence and abuse of other substances (Windle et al. 2009). Heavier alcohol consumption during childhood, early, middle and late adolescence significantly predicts episodes of major depressive disorder as well as alcohol dependency and substance use disorders in adulthood (Brook et al. 2002). Alcohol-related health inequalities arise already during teenage, when alcohol use and drunkenness differentiate according to school performance and school-career. Alcohol use and drunkenness are on average more common among adolescents with poor academic performance compared to those adolescents with good academic performance (Rimpelä 2017). Hingson and colleagues (2006) demonstrated that adults who reported that they started drinking prior to age 14 years were 1.8 times more likely to develop alcohol dependency. Early drunkenness is also a strong predictor of such problem behaviours as smoking, cannabis use, sustaining injuries and involvement in fights (Kuntsche et al. 2013). Adolescent AUD significantly predicts later AUD, substance use disorder, depression and elevated levels of antisocial personality disorder symptoms by early adulthood. For the majority of adolescents, AUD are not benign conditions that resolve over time (Rohde et al. 2001).

Adolescence is an important neurodevelopmental period. Some neuropsychological and neural features predate adolescent substance use, making some adolescents more likely to engage in heavy alcohol consumption and drug use (Squeglia and Gray 2016).

Findings suggest that poorer neuropsychological functioning in tests of inhibition and working memory, smaller brain grey and white matter volume, changes in white matter integrity and altered brain activation during inhibition, working memory, reward and resting state are pre-existing neural features that relate to increased substance use during adolescence (Squeglia and Gray 2016). Inhibition or impulse control has been suggested to be a key cognitive function in regulating substance use (Lopez-Caneda et al. 2014).

Heavy alcohol and drug use impairs normal neural development and cognitive functioning.

After substance use is initiated, alcohol and cannabis use are associated with poorer cognitive functioning in tests of verbal memory, attention, cognitive control, and overall

IQ. Heavy alcohol consumption during adolescence is related to accelerated decreases in grey matter and attenuated increases in white matter volume (Squeglia and Grey 2016).

Drug use itself has been found to be significantly related to substance use disorders (Brook et al. 2002) and early onset of substance use is a robust predictor of future substance use disorders (Grant and Dawson 1998). In general drug users have both higher rates and more severe levels of psychological impairments than do individuals who do not use drugs (Brook et al. 2002). Cannabis is the most common illicit drug in adolescence (Raitasalo et al. 2015, Rubino et al. 2012). Heavy adolescent cannabis use may affect maturational refinement by disrupting the regulatory role of the endocannabinoid system and may increase the risk of cognitive abnormalities, psychotic illness, mood disorders and other illicit substance use later in life (Rubino et al. 2012). Further, cannabis use in adolescence has been suggested to be a greater risk for lower educational attainment than alcohol consumption (Silins et al. 2015).

2.3.6 Individual, familial and socio-demographic correlates

High sensation seeking in adolescence is associated with engagement in risk-taking behaviours, especially substance use (Ortin et al. 2012, Bekman et al. 2010). Sensation seeking is a personality trait defined by the seeking of varied, novel, complex and intense sensations and experiences and the willingness to take physical, social, legal and financial risks for the sake of such experiences (Zuckerman 1994, Ortin et al. 2012). Health-risk behaviours among adolescents are influenced by the behaviors of their close friends, who tend to engage in similar behaviours. These similarities increase with age and, among adolescents, alcohol and substance use have been observed to escalate primarily through peer socialization processes (Sieving et al. 2000, Wills and Cleary 1999). Strong parental support is significantly associated with a reduced risk of alcohol and substance use in both sexes (Simantov et al. 2000, Steinberg et al. 1994). On the other hand, parental substance abuse has been found to be predictive of the same kind of behaviour in the offspring (Kestilä and Rahkonen 2011).

There are inconsistent findings on the association of socio-economic status in childhood and adolescents' alcohol use. Wiles et al. (2007) in their review found little robust evidence to support the assumption that childhood disadvantage is associated with later alcohol use/abuse. Melotti et al. (2011) found different directions in the association between adolescent alcohol use and different socio-economic indicators. Adolescents who came from a higher-income household in early childhood were more likely to use alcohol. However, the offspring of mothers with more educational qualifications were less likely to use alcohol. According to the study by Piko and Fitzpatrick (2007) the relationship between SES and drinking is inverse, that is, adolescents evaluating themselves as lower and lower-middle class were less likely to report alcohol use. Those students whose parents were unemployed, were less likely to report alcohol use. According to Piko and Fitzpatrick (2007) both mother's and father's

level of education were significantly but inversely related to their children's drinking habits. They suggest that children reporting higher frequency of substance use in high SES families may stem from adolescent's easier access to financial resources to be able obtain alcohol (e.g. more pocket money) or the possible liberal attitudes of higher SES families. On the other hand some authors (Hanson and Chen 2007, Wiles et al. 2007, Lampert and Kuntz 2014) found little evidence or no clear pattern of association between SES and alcohol consumption, and Lemstra et al. (2008) in their review study suggested that the prevalence of alcohol risk behaviour was higher in adolescents with low socio-economic status than in adolescents with higher socio-economic status. Contradictory findings have also been published regarding whether the decline in alcohol use and drunkenness are similar in all socioeconomic groups. Some studies suggest that the decline is stable across SES groups (Richter et al. 2013, Livingston 2014), the others that alcohol use does not decrease but actually increases in marginalized adolescent groups (Hallgren et al. 2012, Healey et al. 2014).

2.4 Depression and substance use in adolescence

2.4.1 Comorbidity between depression and substance use in adolescence

It is well known that depression is associated with alcohol and other substance use (Bukstein et al. 1992, Fergusson et al. 1993, Davis et al. 2008). It has been suggested that the presence of major depression or alcohol use disorder doubles the risks of the second disorder and a further causal association between AUD and MD is one in which AUD increases the risk of MD, rather than vice versa (Boden and Fergusson 2011). Also, more frequent cannabis use has been suggested to be associated with increases in rates of depressive symptoms (Horwood et al. 2012).

Nearly one-third of patients with major depressive disorder also have substance use disorders, and the comorbidity carries a higher risk of suicide and greater social and personal impairment as well as other psychiatric conditions (Davis et al. 2008). Depressive symptoms early in life may signal a risk for increasing involvement in substance use among variously emotionally disturbed adolescents (Wu et al. 2008). According to Sung et al. (2004) boys, but not girls with a history of depression were at increased risk for substance use disorder. Comorbid major depression and alcohol use disorder may lead to early onset, more comorbidity and more severe course of depression (Sher et al. 2008).

It has been suggested that higher adolescent alcohol use, even at subclinical levels, is associated with an increased risk of later problems with depression (Edwards et al. 2014). Comorbid major depressive disorder and alcohol use disorders are rare in adolescence (2%) mostly due to low rates of AUD, but increases in early adulthood (up to 11%) (Briere et al. 2014). According to the findings of Briere et al. (2014) rates of comorbid MDD+AUD did not differ by sex in adolescence, in early adulthood or in adulthood. Prospectively,

adolescent AUD predicted early adult MDD, while early adulthood MDD predicted adult AUD. Further adolescent AUD was predictive of early adult AUD among women but not among men. Compared to non-comorbid disorders, MDD+AUD was associated with higher risk of alcohol dependence, suicide attempt, lower global functioning and life dissatisfaction (Briere et al. 2014). Among substance abusers in clinical samples comorbid depressive disorders have been reported to range from 25% to 69% (Lewinsohn et al. 1994, Bukstein et al. 1992, Deykin et al. 1992, Hovens et al. 1993, Neighbors et al. 1992, Clark et al. 1997).

2.4.2 Development, course and consequences of comorbid depression and substance use

Co-occurrence of depression and alcohol and substance use is associated with more difficulties in both the family and peer environments, but the most distinctive risk factor is that of low family support (Aseltine et al. 1998). According to Lewinsohn et al. (2000) formerly depressed adolescents who had more severe depressive episodes (e.g., longer episode duration, multiple episodes, greater number of symptoms, history of suicide attempts) had an elevated rate of substance use disorder during adolescence, and, in young adulthood. Essau (2007) also reported that substance use is associated with the chronicity of major depressive disorder among adolescents.

Early-onset depressive disorders predict frequent illicit drug use, frequent alcohol use and frequent drunkenness (Sihvola et al. 2008). Cerdá et al. (2013) examined the relationship between depression symptoms and the relative influence of recent and more chronic psychiatric symptoms on alcohol use initiation. They found that cumulative depression symptoms were associated with earlier alcohol use onset.

Earlier alcohol use, on the other hand, significantly predicts later major depressive disorder, alcohol dependence, and substance use disorders in young adults and early drug use is significantly related to later psychiatric disorders (Brook et al. 2002). Alcohol use has been suggested to be a causal factor for adolescent depression (Jane-Llopis and Matytsina 2006). Common psychiatric symptom domains, including depression, often start earlier than substance use and have been repeatedly correlated with substance use across development.

Conduct problems are often thought to be a primary predictor of substance use, but Maslowski and Schulenberg (2013) reported that depressive symptoms potentiate the relation of conduct problems and substance use.

Adolescents using mental health services have a high level of comorbidity and complex psychosocial problems. Internalizing problems such as depression and externalizing problems such as getting drunk frequently and illicit drug use are independently associated with service use (Sourander et al. 2001, Sourander et al. 2004). Substance use and depression often co-occur, complicating treatment of both substance use and depression (Schuler et al.

2015). On the other hand it has been suggested that treatment for adolescent psychiatric disorder often helps to alleviate the substance use disorder as well (Deas et al. 2006), and intervening in earlier appearing depressive symptomatology may lead to a reduction in subsequent adolescent substance use (Maslowski et al. 2014). An important goal of health education, preventive and self-help interventions for depression could further be to reduce substance use. (Cairns et al. 2014.)

2.5 Suicidal ideation in adolescence

2.5.1 Characteristics of suicidal behaviour

Suicide is the second-to-third leading cause of death in adolescence (Windfuhr et al. 2008). Despite its high prevalence and known risk factors, suicidal behaviour in many children and adolescents often goes undetected by parents, teachers and health care providers (Horowitz et al. 2009, Pelkonen et al. 2011). Adolescent suicidality is missed in a significant proportion of cases and is undertreated (Fitzpatrick et al. 2012). According to Husky et al. (2012) in the USA two-thirds of adolescents with suicidal ideation and half of those with a plan or attempt had not had any contact with a mental health specialist in the past year.

Recognition and effective treatment of psychiatric disorders, e.g. depression are essential in preventing adolescent suicides (Pelkonen et al. 2011).

Definitions

Suicidality is defined as all suicide-related behaviours and thoughts including completing or attempting suicide, suicidal ideation or communications (A National Imperative 2002). According to AACAP (2001) suicidal ideation includes thoughts about wishing to kill oneself; making plans of when, where, and how to carry out the suicide; and thoughts about the impact of one's suicide on others. O'Carroll et al. (1996) have proposed definitions of suicidal ideation, communications and behaviours as follows: suicidal ideation includes thoughts of harming or killing oneself, suicidal communications include direct or indirect expressions of suicidal ideation or intent to harm or kill oneself, expressed verbally or in writing, artwork or by other means. Suicidal threats include a special case of suicidal communications, used with intent to change the behaviour of other people. A suicide attempt is a non-fatal, self-inflicted destructive act with the explicit or inferred intention to die. Suicide is a fatal self-inflicted destructive act with explicit or inferred intention to die. Suicidal behaviour ensues as a result of an interaction of socio-cultural, developmental, psychiatric, psychological and family-environmental factors (Bridge et al. 2006).

Gmitrowicz et al. (2003) concluded that there are separate predictors of suicide attempt and suicidal ideation. Suicidal ideation as a common phenomenon (occurring in every third adolescent) should probably be included in the specificity of the puberty process and

considered as a separate phenomenon from suicide attempt. According to these workers' findings the presence of an existing psychiatric diagnosis is most strongly related to the occurrence of suicide attempts (including those repeated), but is not related to suicidal ideation.

2.5.2 Prevalence of suicidal ideation in adolescence

Suicidal behaviours are common among adolescents, with rates approaching those of adults. Due to variations in the definitions, sample characteristics and lack of accurate statistics, the prevalence rates of suicidal ideation are difficult to estimate (Pelkonen et al. 2011).

It is well established that the onset of suicide ideation (Nock et al. 2008) and rates of suicide and suicide-related behaviours increase with age and a gender paradox exists with regard to youth suicidal behaviour: i.e., while suicide rates are higher among boys than girls, girls have higher rates of suicidal ideation and attempted suicide (Cash et al. 2009). The reported onset of suicidal ideation, plans and attempts is highest in the late teens and early 20s (Kessler et al. 1999). Depending on the study the prevalence of suicidal ideation in adolescence varies from 3.6% to 31% (Gmitrowich et al. 2003, Husky et al. 2012, Consoli et al. 2013, Sampasa-Kanyinga et al. 2015, Cluver et al. 2015).

Approximately one-third of young people with suicide ideation go on to develop a suicide plan during adolescence, approximately 60% of those with a plan will attempt suicide, and most of the adolescents who make this transition do so within the first year after onset of suicidal ideation. It is noteworthy that suicidal adolescents typically enter treatment before rather than after the onset of suicidal behaviour. This means that mental health professionals are not simply meeting with adolescents in response to their suicidal thoughts or behaviours, but that adolescents who are clinically sick enough to become suicidal more typically enter treatment before the onset of suicidal behaviours (Nock et al. 2013).

2.5.3 Risk factors of suicidal ideation in adolescence

The vast majority of young people presenting with suicidality have pre-existing mental disorders (Nock et al. 2013). Findings from psychological post mortem studies suggest that more than 90% of people who die by suicide have a psychiatric disorder before their death (Cavanagh et al. 2003). Prior mental disorders are strongly associated with suicidal ideation (Nock et al. 2013). On balance, however, most people with a psychiatric disorder never become suicidal (i.e. never experience suicidal thoughts or carry out suicidal behaviours) (O'Connor et al. 2014). Suicidal thoughts are common in adolescents of both genders and are by no means always associated with other features of psychopathology (AACAP 2001).

Adolescent suicide attempters may differ from ideators suffering from more severe or enduring hopelessness, isolation, suicidal ideation, and reluctance to discuss suicidal thoughts (AACAP 2001). Depressed mood disorders, whether comorbid or not, are associated with suicidal ideation and poor psychosocial functioning in adolescence (Tuisku et al. 2006). Panic attacks among girls and disruptive behaviour among boys increase suicidal ideation (AACAP 2001). Substance abuse is a strong risk factor for suicidal thoughts and behaviours (Zhang and Wu 2014). According to the findings of Ortin and colleagues (2012) high sensation seeking was positively associated with depressive symptoms and substance use problems and the main effects of sensation seeking on suicidal ideation and suicide attempts remained significant after controlling for depression and substance use (Ortin et al. 2012).

The number of adversities or negative life events experienced seems to have a positive dose-response relationship with juvenile suicidal behaviour. The type of event experienced also appears to matter (Serafini et al. 2015). Bullying is associated with suicidal ideation. Adolescents who were bullied or who bullied others report higher suicidal ideation than adolescents who were neither bullies nor victims (Kaltiala-Heino et al. 1999, Heikkilä et al. 2013). Repeating a year in school seems to be significantly associated to severity of suicide risk (Consoli et al. 2013). School connectedness seems to have protective effects on suicidal ideation (Sampasa-Kanyinga et al. 2015).

Poor family environment, low parental monitoring and poor instrumental and social competence have been suggested to be risk factors for youth suicidal ideation and attempts (King et al. 2001). Adolescent girls and adolescents with poor social and family functioning and those who engage in substance use are at risk of suicidal ideation (a known precursor of suicide attempts) (Delfabbro et al. 2013). It has been suggested that self-reported satisfaction with relationships in the family reduces the likelihood of suicidal thoughts. The best environment for an adolescent is a family with both biological parents. Of the adolescents in non-intact families, those with a step-parent in the family have suicidal thoughts more frequently than those in single-parent families (Samm et al. 2010). Family discord and negative relationships with parents are associated with an increased suicide risk in depressed adolescents and it appears essential to take intrafamilial relationships into account in depressed adolescents to prevent suicidal behaviours (Consoli et al. 2013). Having had a friend who committed suicide seems to increase the likelihood of suicidal ideation and attempts for both boys and girls (Bearman and Moody 2004). Socially isolated females were more likely to have suicidal thoughts, as were females whose friends were not friends with each other (Bearman and Moody 2004). It has been suggested that avoidant coping strategies, negative life events and stressful romantic relationships contribute to higher levels of suicidal ideation while self-esteem and adaptive coping reduce these levels (George and van den Berg 2012).

Suicidal ideation is more frequent in delinquent detained adolescents than in the general population (Suk et al. 2009).

2.5.4 Associations between suicidal ideation and substance use

Substance use is associated with suicidal ideation, planning and attempts among adolescents (Wong et al. 2013, Sampasa-Kanyinga et al. 2015). Alcohol use increases the risk of suicidal ideation and suicidal ideation increases the risk of illicit drug use (Zhang and Wu 2014). Illegal substance use can lead to suicidal thoughts and actions (Gart and Kelly 2015) and substance use may facilitate the transition from suicidal ideation to suicidal behaviour (Bridge et al. 2006).

Alcohol use among adolescents, particularly preteen alcohol use initiation, is an important risk factor for both suicide ideation and attempts (Swahn and Bossarte 2007).

The adolescents reporting a history of heroin use are most likely to have suicidal ideation, a suicide plan and to make suicide attempts. Suicidality is associated with the use of a range of illicit drugs such as cocaine, ecstasy, hallucinogens and inhalants, but also with fairly commonly used marijuana, alcohol and tobacco (Wong et al. 2013).

All substance use including tobacco and marijuana use has been suggested to be associated with increased suicidal ideation and risk of attempting suicide in depressed adolescents (Consoli et al. 2013). On the other hand binge drinking in adolescence has been reported to be associated with suicide attempts even after controlling for depressive symptoms (Aseltine et al. 2009).

The findings confirm the importance of routine screening for substance use in the assessment of adolescent suicide risk (Zhang and Wu 2014).

2.6 Summary of the literature reviewed

Depression is comparatively rare among children, but common among adolescents, with up to 25% lifetime prevalence by the end of adolescence. In childhood, girls are no more commonly depressed than boys, but in adolescence twice as many girls as boys are depressed. Depression in adolescents leads to impairment and imposes significant burdens on individuals and public health systems. Depression in adolescence is associated with increasing levels of psychosocial dysfunction, low educational achievements and physical and mental health problems later in life. Early onset depressions are frequent, recurrent, and familial disorders that tend to continue into adulthood, and they are frequently accompanied by other psychiatric disorders. Adolescents with depressive symptoms below the diagnostic threshold also have symptom related impairment. Adolescent depression is underdiagnosed and undertreated. Low family socio-economic status is a known risk factor for adolescent depression. A problem in many earlier time trend studies on adolescent depression is that they have not used comparable measurement instruments. There are few studies on the prevalence of depression in youth, and even fewer studies on possible changes in adolescent depression over time in Finland.

Alcohol is the drug of choice for youth. Like depression the prevalence of alcohol use increases during adolescence. Alcohol use and abuse occur on a continuum and problems associated with alcohol use are often seen long before diagnosable dependence. Teen alcohol use is a major public health problem and association have been established between adolescent alcohol involvement and a range of adverse consequences largely the same as those of depression.

There are contradictory findings regarding the association between socioeconomic status in the family and adolescent alcohol use. Some authors reported that adolescents living in high SES families report higher frequency of alcohol use. Some authors reported no clear association between SES and alcohol consumption. Some authors reported adolescent alcohol use is more common in low SES families than in high SES families (Lemstra et al. 2008).

Depression is associated with alcohol and other substance use. Substance use problems in adolescents tend to co-occur with other psychiatric conditions, and approximately 75% of adolescents with current alcohol and/or drug use disorders also meet the criteria for mood, anxiety or conduct disorders.

The vast majority of adolescents with suicidal behaviours have pre-existing mental disorders. Depression is a strong predictor of suicidal thoughts. Suicidal ideation is associated with depression and depression is associated with substance use. Binge drinking in adolescence has been reported to be associated with suicide attempts even after controlling for depressive symptoms. There is only little research on adolescents regarding any possible independent association between frequent alcohol use, drunkenness and substance use other than alcohol and severe suicidal ideation.

There are contradictory views on trends over time in adolescent depression. Thus research conducted in community samples is still needed. The role of socio-economic status in trends of depression has not been explored.

Trends in adolescent alcohol use and drunkenness vary by country. Adolescent frequent drinking and drunkenness have shown a decreasing trend in Finland and in many other western countries in the 2000s, but we do not know whether the declining trends in frequent drinking and drunkenness are similar across different SES groups.

Due to the same measurement and the same collection method throughout the study and using large nationwide samples the School Health Promotion Study provides an excellent opportunity to study trends in depression and health behaviours over time in middle adolescence.

Still fewer studies have looked for the changes in the association between alcohol use and depression across different socioeconomic groups over time. Therefore research investigating whether trends in adolescent alcohol use and drunkenness are similar across different socio-economic groups over time and whether depression plays role in differentiating trends in alcohol use between groups is definitely needed.

3 AIMS OF THE STUDY

This study aimed to examine the associations between depression and the use of alcohol and other substances in a large middle-adolescent population. Further objects of interest were prevalence of depression and changes therein across different socio-economic groups, and temporal trends in adolescent alcohol use according to socio-economic status and depression. A further aim of the study was to investigate the association between severe suicidal ideation and substance use.

The specific aims of the study were:

1. To investigate the associations between self-reported depression and alcohol and other substance use and to detect potential gender differences in the associations of depression with substance use in adolescence. (Study I)
2. To investigate the associations between self-reported severe suicidal ideation and use of alcohol and other substances and to detect potential gender differences in the associations of suicidal ideation with substance use in adolescence. (Study II)
3. To examine changes in self-reported adolescent depression between 2000–2001 and 2010–2011, and further to ascertain whether changes over time vary according to the socio-economic background of the family in terms of parental unemployment and education. (Study III)
4. To examine if the time trends in adolescent alcohol use and drunkenness are similar in different socio-economic groups, and whether depression plays a role in differentiating between trends in alcohol use between these groups. (Study IV)

4 MATERIALS AND METHODS

The present study is based on data collected in the School Health Promotion Study.

4.1 Procedures

The School Health Promotion Study by the National Institute for Health and Welfare is a questionnaire survey designed to examine the health, health behaviour and school experiences of Finnish teenagers and has been conducted annually since 1995 in April among 8th and 9th graders in different parts of Finland. Studies I and II are based on the 1997 survey, carried out in the latter half of the spring term. Since 2000 the data collection has taken place in different regions in odd and even years so that pooled samples of consecutive years (2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009, and 2010–2011) cover the whole country. Studies III and IV are based on the pooled 2-year data time series (2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009, and 2010–2011).

The adolescents completed the questionnaire anonymously during a school lesson under the supervision of a teacher, who did not interfere with the responses. Participants were informed both orally and in writing about the nature of the study as well as the voluntary nature of participation and further that returning the survey was considered consent to participate. The questionnaires took 30–45 minutes to complete and were then placed in an envelopes, sealed and returned directly to the research centre. The study has been duly approved by the Ethical Committees of Pirkanmaa Hospital District and the National Institute for Health and Welfare. The National Institute for Health and Welfare was responsible for collecting and storing the data and for granting researchers permissions to use it.

4.2 Subjects and dropout

The material of Studies I and II comprises the responses of pupils of the 8th and 9th grades of comprehensive schools in two regions of Finland (Vaasa and Tampere) where almost all schools participated. The age of the respondents was 14.3–16.3 years. Of the 20,213 pupils in the 113 participating schools, 17,643 (87%) were present on the day of the survey and returned the questionnaire. The drop-out rate due to absence from school on the survey day was thus 13%. Altogether 1,179 responses (6.7%) (boys 7.8% vs. girls 5.5%, $p < 0.001$) were

excluded due to incomplete responses on the depression rating scale. The size of the final sample for analysis was thus 16,464. Of the respondents 81.2% were living with both their parents, and 90.1% of parents had higher than basic education and 66% of respondents reported that neither parent had been unemployed or laid off during the past 12 months.

Studies III and IV are based on the School Health Promotion Surveys of 2000–2011. The survey was sent to every municipality in Finland, half the country in even-numbered years and the other half in odd-numbered years, so that 2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009 and 2010–2011 cover the whole country. The municipalities decided if the schools in their area would participate in the survey. The number of schools participating in the survey ranged from 578 to 831 biennially. The data of Studies III and IV include the 535 schools participating in all six of the surveys (2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009 and 2010–2011). Each biennial cohort covered more than 75% of the whole age cohort in the country. Altogether, 618,084 (94,635–108,320 biennially) pupils were present on the survey days and returned the questionnaire in these schools. Approximately 10 % to 15% of pupils were absent from school due to illness or other reasons. Subjects (0.8%) with incomplete responses on frequency of alcohol use, subjects (0.8%) with incomplete responses on drunkenness, subjects (0.6%) with incomplete responses on the depression rating scale and subjects (6.6%) with incomplete responses on parental employment or parental education were excluded from the analyses. The timing of the study, and sample and data collection methods were held constant in each survey.

4.3 Measures

Depression

Depression was measured by a modification of the 13-item short version of the Beck Depression Inventory (Beck and Beck 1972, Beck et al. 1974), which has been validated in Finnish (Raitasalo 1995) in Studies I and II. The 13-item BDI consists of statements describing increasing intensity of depressive emotions and cognitions scored 0–3 each, the maximum score thus being 39. Scores 0–4 are classified as no depression, 5–7 as mild, 8–15 as moderate, and 16 and more as severe depression (Beck and Beck 1972).

In Study I, depression scores were dichotomized to none/mild (0–7) and moderate/severe (8–39).

In Study II the 12 BDI items other than suicidality were used to indicate depressive symptoms in order to control for the confounding effect of depressive symptoms in the relationship between suicidal ideation and alcohol or other substance use. The depression sum score, the 12 BDI items other than suicidal ideation, was used in analyses as continuous variable.

In Studies III and IV depression was measured with a 12-item version of the R-BDI (Raitasalo 2007), a modification of the 13-item Beck Depression Inventory (BDI) (Beck and Beck 1972, Beck et al. 1974) validated in Finnish (Raitasalo 1995, 2007). A 12-item version that omitted the item eliciting suicidal ideation was used, because in 1998 the Ministry of Education and Culture disapproved of including this item in a school survey, fearing that asking about suicidality might provoke it. Kaltiala-Heino et al. (1999) previously demonstrated that the 12-item version is best used with the same cut-off points as the original 13-item BDI (Kaltiala-Heino et al. 1999b). Scores of 0–4 were classified as no depression, 5–7 as mild, 8–15 as moderate, and 16 and over as severe depression (Beck and Beck 1972) in Study III. Depression scores were dichotomized to no (15 or less) and severe (Beck 16 or more) in Study IV.

Alcohol use

In Studies I and II alcohol use was measured by two categorised variables concerning the frequency of the adolescent's alcohol use and cumulative drunkenness. Frequency of alcohol use was enquired as follows: "How often do you use alcohol, e.g. half a bottle of beer or more?" The five response alternatives were: "once a week or more frequently/a couple of times a month/about once a month/less frequently/I don't use alcohol". The question on life time cumulative drunkenness was phrased as follows: "Did you ever drink so much alcohol that you get really drunk?" The five possible responses were: "never/once/2–3 times/4–10 times/more than 10 times".

In Study IV frequency of alcohol use was measured by the same variable as in Studies I and II. However, in the analyses, frequency of alcohol use was dichotomized to once a week or more frequently vs. less often or not at all.

In Study IV the question concerning drunkenness was phrased as follows: "How often do you drink so much alcohol that you get really drunk?" The four response alternatives were: "once a week or more frequently/ about once or two times a month/ / less frequently/ never". In the analyses, frequency of drunkenness was dichotomized to once a week or more vs. less often.

Substance use other than alcohol

Use of substances other than alcohol was elicited by separate questions concerning experimentations with different substances in Studies I and II. Questions were formulated as follows: "Did you ever experiment with or use marijuana or hashish? (Similarly: inhalants/alcohol and medicines together/medicines (sedatives, sleeping pills or pain killers, without alcohol) with intoxicating effect/heroin, cocaine, amphetamine, LSD or other corresponding drugs)". The response alternatives for each question were: "never/ once/2–4 times/5 times or more". A sum score was formed indicating experimentation with/consumption of any of the substances studied. The resulting response categories in

Studies I and II were: no use of any substance/once/2–4 times/5 times or more use of some substance.

Sociodemographic and family background variables

The sociodemographic and family background variables ascertained in Studies I and II were: age (continuous) and sex, years resident in the present area (<1 year/1–4 years/5–9 years/10 years or more), parental education (basic/vocational school/college level/academic), unemployment in the family during the past 12 months (none/one parent/both parents), family structure (family intact/step family/single-parent family/living apart from parents) and degree of urbanization of residential area (urban centre/urban residential area/suburban area/rural/remote villages/settlements).

In Study III the sociodemographic and family background variables recorded were: sex, parental education level, unemployment in the family during the past 12 months, and family structure (family intact/single-parent or step family/living apart from parents). Parental education level was categorized as low (basic only), medium (vocational school), or high (polytechnic or university level/academic, college+ vocational) based on the parent with the highest level of education. Parental unemployment was elicited as follows: “Have your parents been unemployed or been laid off work during the past 12 months.” The response alternatives were: “not at all/ one of the parents/both parents.” Unemployment in the family was dichotomised to none versus one parent/both parents, and family structure as living with both parents versus other.

In Study IV the sociodemographic and family background variables were the same as in Study III except family structure, which was not included in the study.

Suicidal ideation

In Study II suicidal ideation was elicited with one of the items on the Beck Depression Inventory (Beck and Beck 1972) enquiring about thoughts of self-harm. In this item the respondent is asked to choose the alternative best describing her/himself from: “I have never had suicidal thoughts” or “I don’t think or want to hurt myself”; and “I feel that it would be better, if I was dead” or “I have definite plans for committing suicide” or “I would kill myself if I had the chance”. The adolescents were classified as having severe suicidal ideation (suicidal ideation with a plan) if they chose either “I have definite plans for committing suicide” or “I would kill myself if I had the chance”.

4.4 Statistical analyses

The associations between depression, alcohol use and use of substances other than alcohol (I) were first analysed by cross-tabulation and tested using chi-square test. Logistic

regression was applied to study the multivariate associations. Multivariate analyses were carried out separately for boys and girls. Age was analysed as a continuous variable; other variables were categorized. First, independent variables alcohol and other substance than alcohol were tested, and age was added into model. Second, sociodemographic variables were added into the model. Analyses were carried out using the SPSS 6.1 software package.

Associations of suicidal ideation with alcohol use and use of substances other than alcohol (II) were first analysed by cross-tabulation and tested with chi-square test. Logistic regression was applied to study the multivariate associations using suicidal ideation as a dependent variable. Age and depressive symptoms were analysed as continuous variables. First, the association between each of the alcohol and substance use other than alcohol variables with suicidal ideation was tested controlling for age and depressive symptoms. Next, use of alcohol and substances other than alcohol were tested simultaneously in the first step without adjusting for confounders, and second, controlling for age and depressive symptoms. Finally, sociodemographic variables were added into the model. SPSS 9.1 software package was used to carry out the analyses.

In the depression time-trend study (III), multivariate associations were studied using multinomial logistic regression. Logistic regression is used when a dependent variable is dichotomous. Multinomial logistic regression can be used when a dependent variable may have more than two values (KvantiMOTV 2009). Depression was entered as the dependent variable. In the first model, categorical time periods (2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009 and 2010–2011) were entered as an independent factor, with the period 2000–2001 entered simultaneously as a reference category. In the second model, grade at school, family structure, unemployment in the family and parental education were added into the model as covariates. In addition to this, instead of categorical time periods, time was modelled also as a continuous factor. Finally, interaction of parental education with parental unemployment was modelled as factor with family structure and grade at school as covariates separately for each time period from 2000–2001 to 2010–2011. Analyses were performed separately for boys and girls. Time effect was studied using time as a continuous covariate variable in the models. Software package SPSS 18.0 was used to carry out the analyses.

In Study IV, the distributions of frequency of alcohol use, frequency of drunkenness, depression and socio-economic variables from 2000–2011 were studied using cross-tabulation. Time was categorized into 4-year intervals (2000–2003, 2004–2007, 2008–2011), and those intervals were analyzed to model the frequencies of drinking or drunkenness via logistic regression. Cochran-Armitage trend test was used to detect the presence of an association between frequencies of dichotomized alcohol use, drunkenness, depression and unemployment with time from year 2000 to year 2011. Linear-by-linear associations (by Mantel-Haagel chi-square test) were measured to show time trends for 3-class parental education. Models were performed separately for depressed and non-depressed boys and girls to explain frequencies of drinking and drunkenness by the combined variable

of parental employment and education. Combined parental employment and parental education formed new variables consisting six categories (high level of education and being employed, high level of education and being unemployed, medium level of education and being employed, medium level of education and being unemployed, low level of education and being employed, low level of education and being unemployed). The high level of education and employed category was used as a reference category. Software package SPSS 20.0 was used for the analyses, except that Cochran-Armitage trend-tests were performed by StatXact-4 version 4.0 (Cytel Software Corporation).

5 RESULTS

5.1 Associations between depression and alcohol and substances other than alcohol use (I)

Girls reported moderate or severe depression almost twice more often than boys (11%/6%, $p < 0.001$). Girls reported trying alcohol slightly more often than boys (70%/66%, $p < 0.001$), but frequent alcohol use (girls 7%, boys 10%, $p < 0.001$) and drunkenness (girls 10%, boys 13%, $p < 0.001$) were more common among boys than among girls. On the other hand girls reported experimentations with substances other than alcohol more often than boys (20%/13%, $p < 0.001$) (Study I: Table 1). In more detail, of the girls/boys, 16%/5% had experimented with/taken pills and alcohol together, 4%/5% hashish, 4%/6% inhalants, 4%/2% pills and 1%/1% hard drugs.

In the unadjusted univariate analysis all substance use variables were associated with depression in both sexes. In the multivariate analysis using the alcohol use variables and the substance use other than alcohol as independent variables and controlling for age, a significant risk of depression was related to frequent alcohol use (once a week). Among both boys (OR 1.9, 95% CI 1.2–2.9), and girls (OR 1.8, 95% CI 1.3–2.6) the risk was almost two-fold. Cumulative drunkenness during lifetime no longer significantly predicted depression. Even an experiment with substances other than alcohol predicted a two-fold risk for depression among both boys (OR 2.0, 95% CI 1.5–2.8) and girls (OR 2.0, 95% CI 1.6–2.5). Having taken substances other than alcohol 10 times or more predicted a six-fold risk for depression (OR 6.0, 95% CI 4.2–8.5) among boys and a five-fold risk (OR 5.0, 95% CI 3.7–6.8) among girls. Adding the sociodemographic variables into the model did not change the associations detected (Table 1). In addition to frequent alcohol use and use of substances other than alcohol, depression among girls was associated with living for a short time in the same area (OR 1.4, 95% CI 1.1–1.8), living in step family (OR 1.3, 95% CI 1.0–1.7), living in remote villages/settlements (OR 1.4, 95% CI 1.0–1.9) and parents' low level of education (OR 1.5, 95% CI 1.1–2.1). Among boys depression, in addition to frequent alcohol use and use of substances other than alcohol was associated with unemployment in the family (one parent unemployed OR 1.5, 95% CI 1.2–1.9, both parents unemployed OR 2.1, 95% CI 1.4–3.3) (Table 1).

Table 1. Risk of depression (OR, 95% CI) according to frequency of alcohol use and experimentations with other substances among 14- to 16-year-old adolescents by sex controlling for age and sociodemographic background (family structure, parental education, parental unemployment, degree of urbanisation and years since moving).

	Boys		Girls	
	OR	95% CI	OR	95% CI
Frequency of alcohol use				
No alcohol use	1.0		1.0	
Occasionally	1.6	1.2–2.3	1.3	1.0–1.8
Once a month	1.1	0.9–1.6	1.5	1.1–2.0
Twice a month	1.4	0.9–2.1	1.4	1.0–1.9
Once a week or more often	2.0	1.2–3.1	1.8	1.2–2.6
Experimentations with other substances				
Never	1.0		1.0	
Once	1.8	1.3–2.6	2.0	1.6–2.6
2–4 times	2.1	1.3–3.3	2.8	2.2–3.7
More than 10 times	5.5	3.7–7.5	5.4	3.7–7.4
Lifetime drunkenness				
Never				
Once				
2–3 times	P> 0.05		P> 0.05	
4–10 times				
More than 10 times				
Family structure				
Lives with both parents			1.0	
Has a step parent	P> 0.05		1.3	1.0–1.7
Lives with one parent			P>0.05	
Lives apart from parents			P>0.05	
Parental education				
Academic			1.0	
College level	P> 0.05		P>0.05	
Vocational level			P>0.05	
None			1.5	1.1–2.1
Unemployment in the family				
None	1.0			
One parent	1.5	1.2–1.9	P>0.05	
Both parents	2.1	1.4–3.3		
Years living in the same area				
9 years or more			1.0	
5–9 years	P> 0.05		P>0.05	
1–4 years			1.4	1.1–1.8
Under 1 year			P>0.05	
Living area				
Urban centre			1.0	
Urban residential area	P> 0.05		P>0.05	
Suburban area			P>0.05	
Rural settlement			P>0.05	
Remote settlement			1.4	1.0–1.9

5.2 Associations between suicidal ideation and use of alcohol and substances other than alcohol

Severe suicidal ideation was reported by 2.4% of girls and 2.1% of boys ($p= 0.19$). In the univariate analysis both alcohol use variables (frequency of alcohol use, lifetime drunkenness) and especially use of substances other than alcohol were associated with severe suicidal ideation in both sexes.

The bivariate association of each of the variables alcohol use (in boys, occasionally, once a month, twice a month, weekly alcohol use, in girls, once a month, twice a month, weekly alcohol use, and in boys, once, 2–3 times, 4–10 times, over 10 times experiences of drunkenness, in girls 2–3 times, 4–10 times, over 10 times experiences of drunkenness) and use of substances other than alcohol (once, 2–4 times, over 10 times among both in boys and girls) studied with severe suicidal ideation persisted in logistic regression adjusting for age and depression. Even occasional alcohol use significantly increased the risk for severe suicidal ideation among boys (OR 2.6, 95% CI 1.3–5.1). The risk for severe suicidal ideation was 2-fold (OR 2.2, 95% CI 1.2–3.9) in girls reporting alcohol use once a month. Drunkenness even once was a significant risk for severe suicidal ideation among boys (OR 2.4, 95% CI 1.2–4.8), likewise drunkenness 2–3 times among girls (OR 1.9, 95% CI 1.1–3.9). Even experimentation with substances increased the risk for severe suicidal ideation 4-fold among boys (OR 4.2, 95% CI 2.5–6.8) and two-fold (OR 2.4, 95% CI 1.5–3.7) among girls (Study II: Table 2).

When the two alcohol use variables and the use of substances other than alcohol were entered into the logistic regression model simultaneously, associations between severe suicidal ideation and frequent alcohol use (in girls, alcohol use weekly OR 2.4, 95% CI 1.2–5.0, in boys, alcohol use twice a month OR 2.3, 95% CI 1.1–4.8 or weekly OR 2.9, 95% CI 1.3–6) persisted. The association between experiences of drunkenness and severe suicidal ideation disappeared. Any use of substances other than alcohol was a significant risk for severe suicidal ideation in both boys (OR 3.6, 95% CI 2.2–5.6) and in girls (OR 2.1, 95% CI 1.4–3.4) (Table 2). When this model was tested further controlling for age and depression, any experiences of substance use other than alcohol remained significantly associated with severe suicidal ideation in both sexes (in boys, OR 3.2, 95% CI 1.9–5.3, in girls, OR 1.7, 95% CI 1.1–2.8). Among boys, frequent alcohol use also emerged as a risk (alcohol consumption twice a month OR 2.8, 95% CI 1.2–6.5, alcohol use weekly OR 2.6, 95% CI 1.1–6.6). Adding the sociodemographic background variables (degree of urbanisation of residential area, years resident in the present area, unemployment in the family, family structure, parental education) into the model did not change the associations detected.

Table 2. Risk (OR, 95% CI) for severe suicidal ideation according to frequency of alcohol use, drunkenness and use of substances other than alcohol when alcohol and substance use variables are entered into the model simultaneously among 14–16-year-old adolescents

	Boys			Girls		
	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Frequency of alcohol use						
None	1.0	1.0	1.0	1.0	1.0	1.0
Occasionally	1.7 (0.9–3.3)	1.9 (0.9–4.2)	2.4 (1.0–6.0)	1.2 (0.7–2.2)	1.3 (0.7–2.5)	1.4 (0.7–2.9)
Once a month	1.3 (0.6–2.9)	1.2 (0.5–3.2)	1.3 (0.4–3.9)	1.5 (0.7–2.9)	1.3 (0.6–2.7)	1.5 (0.7–3.3)
Twice a month	2.3 (1.1–4.8)	2.8 (1.2–6.5)	2.8 (1.0–7.5)	1.7 (0.9–3.3)	1.5 (0.7–3.0)	1.9 (0.9–4.2)
Once a week or more often	2.9 (1.3–6.2)	2.6 (1.1–6.6)	3.3 (1.2–9.5)	2.4 (1.2–5.0)	1.7 (0.8–3.8)	2.3 (1.0–5.4)
Drunkenness						
Never	1.0	1.0	1.0	1.0	1.0	1.0
Once	1.5 (0.8–2.9)	1.4 (0.7–3.1)	1.3 (0.6–3.1)	1.0 (0.5–1.9)	0.9 (0.5–1.9)	1.0 (0.5–2.2)
2–3 times	1.6 (0.8–2.9)	1.6 (0.8–3.2)	1.4 (0.6–3.2)	1.1 (0.5–1.8)	1.1 (0.6–2.1)	1.1 (0.6–2.2)
4–10 times	1.7 (0.9–3.3)	1.8 (0.8–3.7)	1.9 (0.8–4.4)	1.7 (0.9–3.0)	2.0 (1.1–3.8)	2.1 (1.1–4.2)
10 times or more	1.3 (0.6–2.4)	1.3 (0.6–2.8)	1.4 (0.6–3.2)	1.6 (0.9–3.0)	1.7 (0.9–3.4)	1.8 (0.9–3.8)
Use of substances other than alcohol						
Never	1.0	1.0	1.0	1.0	1.0	1.0
Once	3.6 (2.2–5.6)	3.2 (1.9–5.3)	2.8 (1.5–5.1)	2.1 (1.4–3.4)	1.7 (1.1–2.8)	1.9 (1.2–3.2)
2–4 times	4.4 (2.5–7.5)	3.5 (1.8–6.5)	3.8 (1.9–7.6)	4.0 (2.6–6.2)	3.0 (1.9–4.8)	2.9 (1.8–4.9)
5 times or more	11.9 (7.5–18.9)	6.2 (3.5–11.2)	7.1 (3.7–13.6)	5.5 (3.4–9.0)	2.5 (1.5–4.4)	2.8 (1.6–5.1)

Model 1= unadjusted Odds Ratios

Model 2= adjusted for age and depressive symptoms

Model 3= adjusted for age, depressive symptoms, family structure, parental education, unemployment in the family, degree of urbanisation of residential area, and years resident in the present area.

5.3 Trends over time in adolescent depression (III)

Baseline characteristics of the study population

Among the participants the proportion of males was 50.3%, that of females 49.7%. The percentage of 8th graders was 50.5% and that of 9th graders 49.5%. At the time of the surveys, the 8th graders were 14–15 years old and the 9th graders 15–16 years old. About a third of the participants lived in a family where one or both parents had been unemployed or laid off during the past 12 months (Study III: Table 1). More than half of the participants lived in a family where one or both parents had high education; this proportion increased over the years. Seventy-six per cent of respondents were living in intact families.

5.3.1 Proportion of depression in different socio-economic groups

The proportion of depression was higher among girls than among boys in all socio-economic groups except the group of adolescents whose parents had only a basic school education and were unemployed (the proportion of severe depression in this group was 12.8% among boys vs. 11.5% among girls in 2010–2011). The proportion of severe depression was higher

among both boys and girls whose parents had a low education level or were unemployed, than among boys and girls whose parents had a medium or high level of education or were employed.

Regardless of parents' educational background the proportion of mild and moderate depression were also higher among the boys and girls whose parents were unemployed than among the adolescents whose parents were employed.

5.3.2 Changes over time in adolescent depression

The rate of severe depression increased slightly among girls during the study period. Severe depression was reported by 4% of girls and 2.1% of boys in 2000–2001 and by 4.7% and 2.2% respectively in 2010–2011 (Figure 1). When studying the entire period, the prevalence of severe depression peaked among girls in 2010–2011 and among boys it varied slightly (from 2.0% to 2.2%) during the years of the study (Figure 1). The prevalence of severe depression increased especially among those boys and girls whose parents were unemployed and had only a basic school education. Among boys and girls whose parents had a low level of education and were unemployed, severe depression was reported by 6.5% and 6.4% respectively in 2000–2001 and by 12.8% and 11.4% respectively in 2010–2011 (Figure 2).

Among girls the odds of reporting severe depression were lower in 2000–2001 than in all the subsequent periods except 2002–2003 in the multinomial regression models. The changes were statistically significant from 2008–2009 in the unadjusted model and in 2004–2005 and from 2008–2009 in the model adjusted for grade, family structure, unemployment and parents' education. (Study III: Table 3). The risk for severe depression increased among both boys (OR 4.49, 95% CI 1.56–5.67 in 2000–2001 and OR 9.93, 95% CI 8.21–12.00 in 2010–2011) and girls (OR 2.93, 95% CI 2.37–3.62 in 2000–2001 and OR 4.86, 95% CI 4.11–5.74 in 2010–2011), whose parents had low level of education and were unemployed. The relative odds of severe depression were higher for those with low-educated and unemployed parents than for those with highly-educated and employed parents. These relative odds were greater for boys than for girls (Table 3). There was also an increasing trend in mild and moderate depression among both boys and girls whose parents had low level of education and had unemployed during the past year.

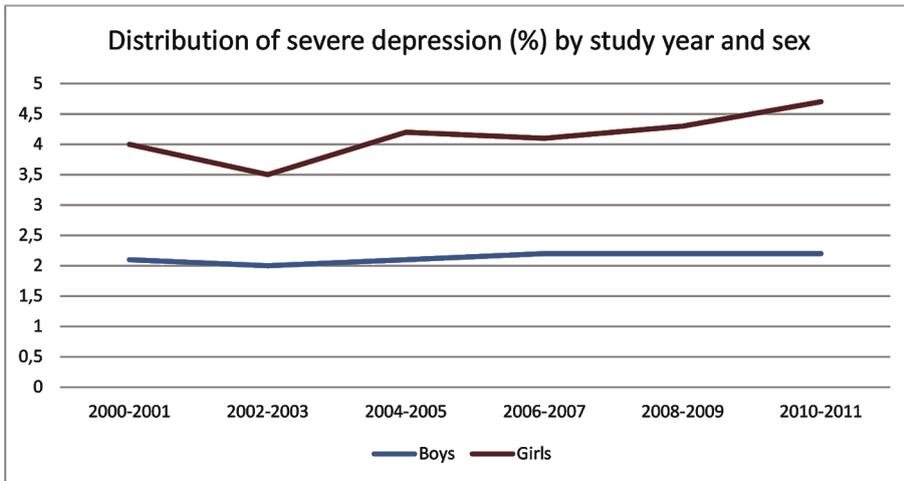


Figure 1.

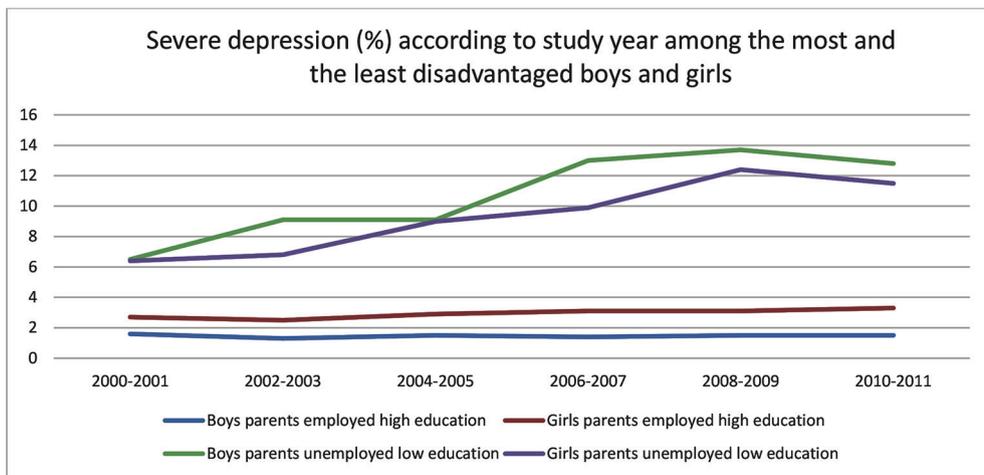


Figure 2.

Table 3. Severe depression (OR, 95% CI) by study year, sex and parents' unemployment and education

Parents' education and employment	2000–2001	2002–2003	2004–2005	2006–2007	2008–2009	2010–2011
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Boys						
High education employed	1.00	1.00	1.00	1.00	1.00	1.00
High education unemployed	1.9 (1.6–2.3)	2.5 (2.0–3.0)	2.0 (1.7–2.4)	2.9 (2.5–3.5)	2.3 (2.0–2.7)	2.0 (1.7–2.4)
Medium education employed	0.9 (0.7–1.1)	0.9 (0.7–1.1)	0.9 (0.7–1.1)	1.1 (0.9–1.3)	0.8 (0.7–1.0)	0.8 (0.7–1.0)
Medium education unemployed	1.3 (1.1–1.6)	1.8 (1.4–2.2)	1.9 (1.5–2.3)	2.8 (2.3–3.4)	2.3 (1.9–2.8)	1.6 (1.2–1.9)
Low education employed	1.4 (1.0–1.8)	2.2 (1.7–2.9)	1.8 (1.4–2.4)	1.8 (1.3–2.5)	2.9 (2.2–3.8)	1.8 (1.4–2.5)
Low education unemployed	4.5 (3.6–5.7)	8.1 (6.5–10.1)	6.9 (5.5–8.5)	12.5 (10.1–15.3)	11.7 (9.4–14.5)	9.9 (8.2–12.0)
N	47586	50774	53057	54315	54132	51116
Girls						
High education employed	1.00	1.00	1.00	1.00	1.0	1.0
High education unemployed	2.0 (1.7–2.4)	2.1 (1.8–2.5)	2.3 (2.0–2.6)	2.1 (1.8–2.4)	2.1 (1.9–2.4)	2.0 (1.8–2.3)
Medium education employed	0.9 (0.7–1.1)	0.9 (0.7–1.1)	0.9 (0.7–1.1)	1.1 (0.9–1.3)	0.8 (0.7–1.0)	0.8 (0.7–1.0)
Medium education unemployed	1.3 (1.1–1.6)	1.8 (1.4–2.2)	1.9 (1.5–2.3)	2.8 (2.3–3.4)	2.3 (1.9–2.8)	1.6 (1.2–1.9)
Low education employed	1.4 (1.0–1.8)	2.2 (1.7–2.9)	1.8 (1.4–2.4)	1.8 (1.3–2.5)	2.9 (2.2–3.8)	1.8 (1.4–2.5)
Low education unemployed	2.9 (2.4–3.6)	3.4 (2.7–4.3)	4.0 (3.3–4.9)	4.2 (3.4–5.2)	5.5 (4.4–6.7)	4.9 (4.1–5.7)
N	47049	49236	51713	54005	54035	51066

Reference group: employed parents with high education

5.4 Trends over time in adolescents' frequent alcohol use and drunkenness (IV)

5.4.1 Changes in frequent alcohol use and drunkenness during the study period

Frequent alcohol use (once a week or more often) and drunkenness (once a week or more often) were most common at the turn of the millennium. Thereafter frequent alcohol use decreased among both boys and girls at every survey. Frequent drunkenness also decreased year by year except for 2004/2005, when frequent drunkenness showed among both sexes a modest peak from the decreasing overall trend. Weekly alcohol use was reported by 18%

of boys and 12% of girls in 2000–2001 and by 8% of boys and 6% of girls in 2010–2011 (Figure 3). Weekly drunkenness was reported by 7% of boys and 4% of girls in 2000–2001 and by 4% of boys and 2% of girls in 2010–2011 (Figure 4). The rates of frequent alcohol use and drunkenness were higher among boys than among girls in all years. However, the differences in frequent alcohol use and drunkenness between boys and girls diminished over time. The difference in weekly alcohol use diminished from 6.3% in 2000–2001 to 1.8% in 2010–2011 (Figure 3) and the difference in frequent drunkenness diminished from 3.2% to 1.4% (Figure 4).

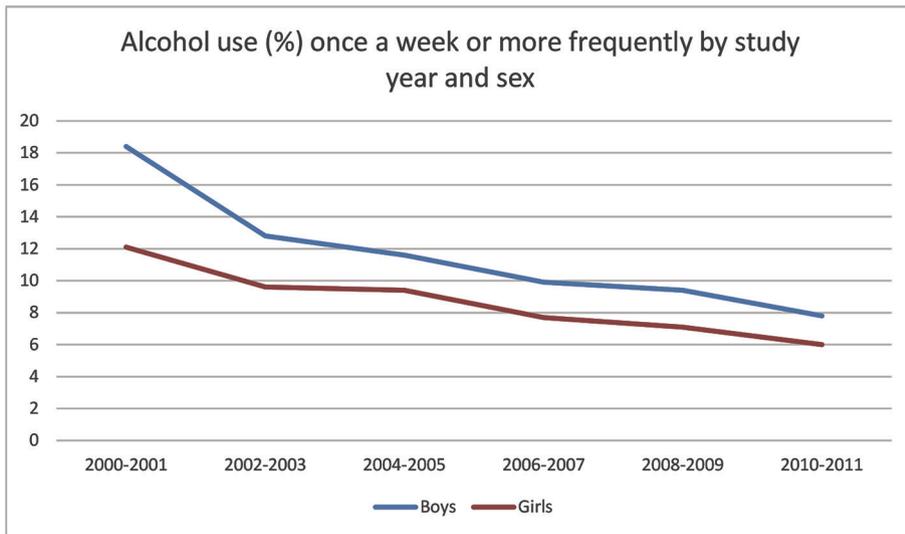


Figure 3.

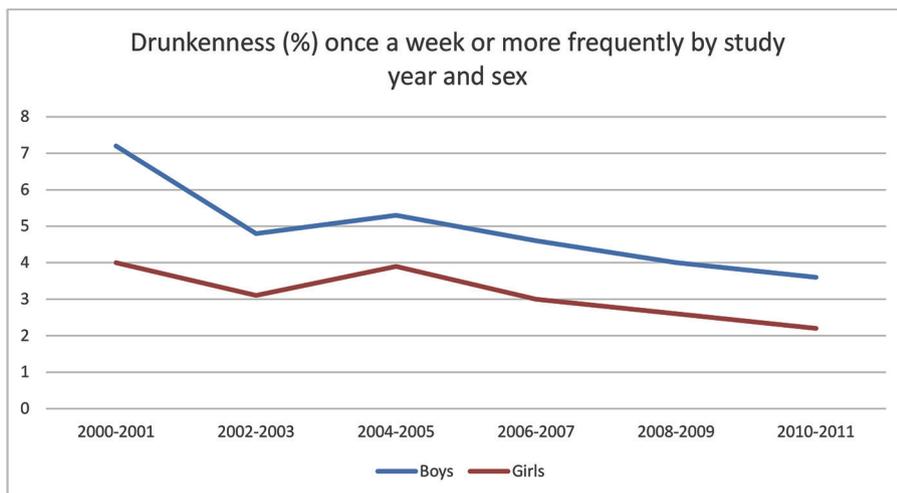


Figure 4.

Frequent drinking and drunkenness in different socioeconomic groups

Compared to adolescents with the most highly educated, employed parents, frequent alcohol use was more common in all other SES groups among both boys and girls (Study IV: Table 2); the same held true for frequent drunkenness (Study IV: Table 3). Furthermore, frequent alcohol use was more common among adolescents with depression than those without depression regardless of SES and frequent drunkenness was more common among adolescents with depression than among those without depression in each SES group.

5.4.2 Changes over time in frequent alcohol use and drunkenness in different socio-economic groups among adolescents with and without depression

Frequent alcohol use and frequent drunkenness showed a decreasing trend over time in all SES groups both among boys and girls. An exception to the general trend was the depressed boys and girls from families with the lowest parental education and parental unemployment. In this group boys/girls reported weekly alcohol use 74.8%/37.4% in 2000–2003. In 2008–2011 these figures were 79.1%/47.6% respectively (Figure 5). In this group weekly drunkenness was reported by 69.1%/22.4% of boys/girls in 2000–2003. In 2008–2011 these figures were 75.8/41.7 respectively (Figure 6).

The differences between the group with the most favourable situation (high level of parental education, no parental unemployment, and no depression) and the group with the least favourable situation (low level of parental education, parental unemployment and depression) clearly increased over time. The OR for frequent alcohol use among boys in the latter group was OR=21.6 (95% CI, 15.2–29.7), and the OR for frequent drunkenness was OR=50.9 (95% CI, 38.0–68.2) in 2000–2003. In 2008–2011, these figures were OR=55.7 (95% CI, 41.9–74.0), and OR=133.5 (95% CI, 102.1–174.7), respectively. Among girls, the OR for frequent alcohol use in the latter group was OR=7.35 (95% CI, 5.6–9.7), and OR for frequent drunkenness was OR=13.2 (95% CI, 9.5–18.4) in 2000–2003. In 2008–2011 these figures were OR=18.4 (95% CI, 4.8–22.9) and OR=48.9 (95% CI, 38.8–61.6), respectively (Table 4).

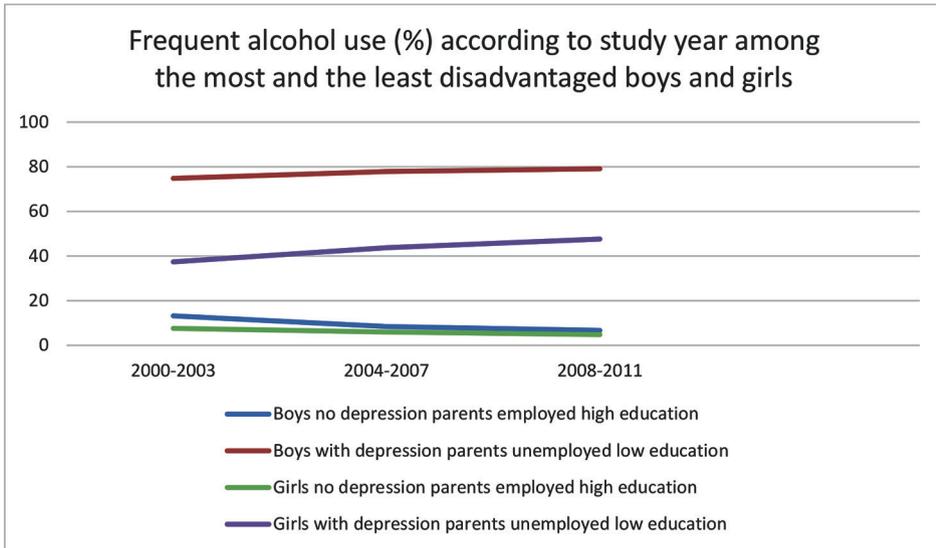


Figure 5.

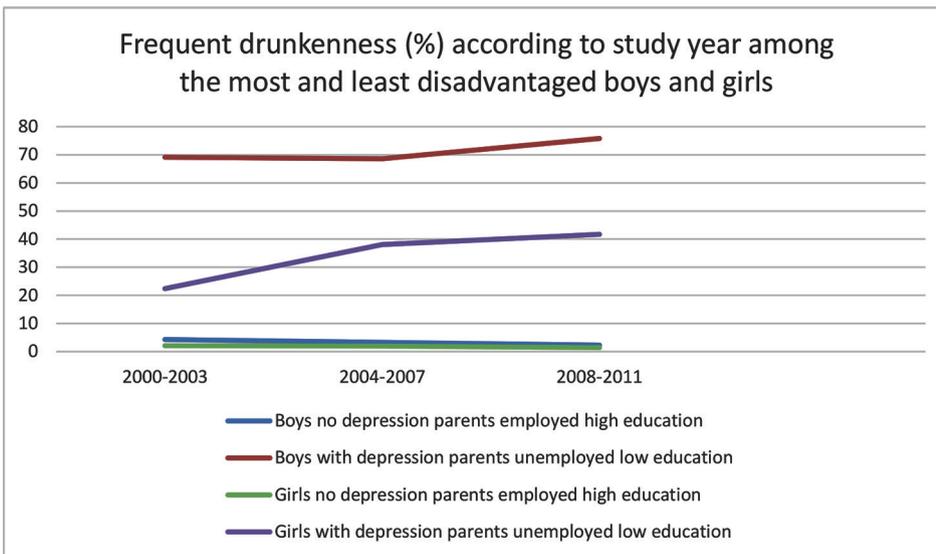


Figure 6.

Table 4. Frequent alcohol use and frequent drunkenness (ORs with 95% CIs) by depression, study year, gender and parental unemployment and education

Parental education and employment by depression	Frequent alcohol use				Frequent drunkenness				
	2000–2003 OR (95% CI)	2004–2007 OR (95% CI)	2008–2011 OR (95% CI)	2000–2003 OR (95% CI)	2004–2007 OR (95% CI)	2008–2011 OR (95% CI)	2000–2003 OR (95% CI)	2004–2007 OR (95% CI)	2008–2011 OR (95% CI)
Boys									
No depression									
High education, employed	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High education, unemployed	1.13 (1.08–1.19)	1.30 (1.23–1.38)	1.19 (1.12–1.27)	1.16 (1.07–1.25)	1.44 (1.33–1.57)	1.24 (1.11–1.38)	1.44 (1.33–1.57)	1.44 (1.33–1.57)	1.24 (1.11–1.38)
Medium education, employed	1.32 (1.21–1.43)	1.56 (1.42–1.73)	1.65 (1.46–1.85)	1.51 (1.33–1.72)	1.77 (1.53–2.05)	2.03 (1.70–2.42)	1.77 (1.53–2.05)	1.77 (1.53–2.05)	2.03 (1.70–2.42)
Medium education, unemployed	1.23 (1.16–1.30)	1.41 (1.33–1.50)	1.42 (1.33–1.52)	1.42 (1.30–1.56)	1.62 (1.48–1.76)	1.73 (1.56–1.91)	1.62 (1.48–1.76)	1.62 (1.48–1.76)	1.73 (1.56–1.91)
Low education, employed	1.39 (1.31–1.47)	1.55 (1.44–1.66)	1.35 (1.24–1.46)	1.53 (1.40–1.68)	1.64 (1.47–1.82)	1.47 (1.29–1.68)	1.64 (1.47–1.82)	1.64 (1.47–1.82)	1.47 (1.29–1.68)
Low education, unemployed	1.39 (1.25–1.54)	2.18 (1.92–2.45)	2.38 (2.09–2.70)	2.06 (1.78–2.38)	3.25 (2.80–3.78)	4.12 (3.49–4.86)	3.25 (2.80–3.78)	3.25 (2.80–3.78)	4.12 (3.49–4.86)
Depression									
High education, employed	4.75 (4.01–5.62)	5.57 (4.77–6.50)	8.32 (7.14–9.69)	8.72 (7.22–10.5)	8.47 (7.07–10.1)	15.0 (12.6–17.9)	8.47 (7.07–10.1)	8.47 (7.07–10.1)	15.0 (12.6–17.9)
High education, unemployed	3.81 (2.97–4.88)	4.51 (3.48–5.84)	6.80 (5.15–8.97)	6.34 (4.72–8.49)	6.79 (5.00–9.21)	11.7 (8.45–16.1)	6.79 (5.00–9.21)	6.79 (5.00–9.21)	11.7 (8.45–16.1)
Medium education, employed	9.86 (6.85–14.2)	7.95 (5.32–11.9)	13.6 (9.27–19.9)	18.4 (12.8–28.4)	13.7 (8.89–21.0)	21.0 (19.0–31.6)	13.7 (8.89–21.0)	13.7 (8.89–21.0)	21.0 (19.0–31.6)
Medium education, unemployed	8.21 (6.64–10.1)	8.09 (6.66–9.82)	11.7 (9.73–14.0)	15.4 (12.4–19.1)	13.7 (11.1–16.9)	24.6 (20.3–29.9)	13.7 (11.1–16.9)	13.7 (11.1–16.9)	24.6 (20.3–29.9)
Low education, employed	5.59 (4.33–7.22)	9.97 (7.81–12.7)	9.03 (6.97–11.7)	11.6 (8.88–15.3)	16.5 (12.8–21.3)	16.2 (12.2–21.6)	16.5 (12.8–21.3)	16.5 (12.8–21.3)	16.2 (12.2–21.6)
Low education, unemployed	21.6 (15.7–29.7)	45.2 (33.1–61.8)	55.7 (41.9–74.0)	50.9 (38.0–68.2)	65.6 (50.2–85.8)	133.5 (102.1–174.7)	65.6 (50.2–85.8)	65.6 (50.2–85.8)	133.5 (102.1–174.7)
Girls									
No depression									
High education, employed	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High education, unemployed	1.40 (1.32–1.49)	1.51 (1.42–1.60)	1.35 (1.26–1.45)	1.47 (1.32–1.64)	1.59 (1.44–1.76)	1.43 (1.28–1.63)	1.59 (1.44–1.76)	1.59 (1.44–1.76)	1.43 (1.28–1.63)
Medium education, employed	1.62 (1.47–1.79)	1.59 (1.41–1.78)	1.57 (1.34–1.79)	2.01 (1.70–2.36)	1.81 (1.50–2.17)	2.06 (1.66–2.56)	1.81 (1.50–2.17)	1.81 (1.50–2.17)	2.06 (1.66–2.56)
Medium education, unemployed	1.42 (1.31–1.53)	1.47 (1.37–1.58)	1.40 (1.29–1.51)	1.52 (1.32–1.73)	1.69 (1.50–1.90)	1.63 (1.43–1.85)	1.69 (1.50–1.90)	1.69 (1.50–1.90)	1.63 (1.43–1.85)
Low education, employed	1.98 (1.86–2.11)	2.09 (1.95–2.25)	1.76 (1.62–1.91)	2.28 (2.04–2.55)	2.55 (2.29–2.85)	2.07 (1.80–2.38)	2.55 (2.29–2.85)	2.55 (2.29–2.85)	2.07 (1.80–2.38)
Low education, unemployed	1.71 (1.52–1.91)	2.13 (1.87–2.43)	2.11 (1.83–2.42)	2.15 (1.79–2.59)	2.52 (2.06–3.07)	3.23 (2.63–3.96)	2.52 (2.06–3.07)	2.52 (2.06–3.07)	3.23 (2.63–3.96)
Depression									
High education, employed	3.93 (3.36–4.60)	3.59 (3.12–4.12)	3.38 (2.91–3.93)	5.74 (4.58–7.18)	4.77 (3.93–5.79)	5.88 (4.80–7.19)	4.77 (3.93–5.79)	4.77 (3.93–5.79)	5.88 (4.80–7.19)
High education, unemployed	4.33 (3.65–5.13)	4.40 (3.70–5.23)	2.96 (2.38–3.68)	6.67 (5.27–8.43)	6.18 (4.91–7.79)	4.62 (3.40–6.27)	6.18 (4.91–7.79)	6.18 (4.91–7.79)	4.62 (3.40–6.27)
Medium education, employed	4.71 (3.45–6.44)	4.88 (3.50–6.81)	5.25 (3.68–7.50)	9.04 (6.15–13.3)	8.22 (5.47–12.3)	7.35 (4.49–12.00)	8.22 (5.47–12.3)	8.22 (5.47–12.3)	7.35 (4.49–12.00)
Medium education, unemployed	4.43 (3.62–5.42)	5.05 (4.24–6.01)	5.13 (4.33–6.06)	6.32 (4.99–8.00)	6.32 (4.99–8.00)	7.86 (6.25–9.89)	6.32 (4.99–8.00)	6.32 (4.99–8.00)	7.86 (6.25–9.89)
Low education, employed	4.68 (3.92–5.58)	4.38 (3.64–5.28)	4.80 (3.96–5.82)	7.82 (6.19–9.87)	6.79 (5.35–8.62)	7.18 (5.51–9.36)	6.79 (5.35–8.62)	6.79 (5.35–8.62)	7.18 (5.51–9.36)
Low education, unemployed	7.35 (5.57–9.69)	12.0 (9.28–15.6)	18.4 (14.8–22.9)	13.2 (9.53–18.4)	29.3 (22.3–38.3)	48.9 (38.8–61.6)	13.2 (9.53–18.4)	29.3 (22.3–38.3)	48.9 (38.8–61.6)

6 DISCUSSION

6.1 Associations between depression and alcohol and substance use

Adolescent depression is often recurrent and is associated with a range of adverse outcomes including social and educational impairments as well as both physical and other mental health problems later in life (Bardone et al. 1998, Thapar et al. 2012, Maughan et al. 2013). Substance use becomes increasingly common during adolescence (Cerdá et al. 2013). Alcohol consumption and drug use during childhood and adolescence, on the other hand, significantly predicts subsequent major depressive disorder, alcohol dependence and substance use disorders in young adults (Brook et al. 2002). It has been suggested that the risk of lifetime alcohol dependence and abuse decreases with each increasing year of age at onset of use (Grant and Dawson 1997). According the study by Grant and Dawson (1997) the rates of lifetime dependence declined from more than 40% among individuals who started drinking at ages 14 or younger to roughly 10% among those who started drinking at age 20 and older. In clinical samples comorbidity, occurrence of two or more disorders at the same time, is common in adolescent depression, substance use disorders being among the most common disorders (Karlsson et al. 2006, Marttunen and Karlsson 2010).

In line with the findings of Reinherz et al. (2000) and Fröjd et al. (2006) girls reported depression twice more often than boys in the full sample of the present study (I, II, III, IV). Depression was more common among girls than among boys in all socio-economic groups, with the exception of the most disadvantaged (parents with low level of low education and unemployed), in which severe depression was more common among boys than among girls. Frequent alcohol use and drunkenness, on the other hand, were more common among boys than among girls (I, II, IV) in the full sample and in all socio-economic groups. This is consistent with the findings of Simons-Morton et al. (2009) and Lampert and Kuntz (2014).

The results of the present study (I) confirmed on the population level the association of depression with alcohol and substance use that has been suggested earlier in clinical adolescent samples (Bukstein et al. 1992, Deykin et al. 1992, Hovens et al. 1993). There was a high co-occurrence of depression with frequent alcohol use and other substance use, although not as high as in clinical samples. The association between depression and any use of substances other than alcohol was stronger than that between depression and frequent alcohol use or frequent drunkenness. The finding concurs with the findings of the study by

Jane-Llopis and Matytsina (2006) reporting that people with illicit drug disorders have the highest rates of comorbid mental disorders. In general population samples people with a substance use disorder have higher occurrence of comorbid mental disorders than vice versa, and people with illicit drug disorders have the highest rates of comorbid mental disorders. There is a strong direct association between the magnitude of comorbidity and the severity of substance use disorders (Jane-Llopis and Matytsina 2006, Boden and Fergusson 2011). Adolescents reporting a greater degree of comorbidity are likely to engage in substance use behaviour more frequently (White et al. 2015).

The findings of the present study (I) suggested that the relationship between the frequency of alcohol and other substance use and depression is approximately dose related: the more frequent alcohol use or experimentations with drugs, the more depression. The finding concurs with the findings of Lewinsohn et al. (1995), Rohde et al. (1996) and Kandel et al. (1999). The risk of depression increased according to increasing use of substances other than alcohol among both boys and girls. The risk of depression was significant among girls reporting even occasional use of alcohol and among boys reporting weekly alcohol use. One explanation for this finding may be that alcohol use among boys was and may still be more acceptable and thus more normative behaviour for boys than girls. The association between frequent alcohol use and depression was stronger than that between drunkenness and depression. This finding might be explained by the pattern among Finnish adolescents of drinking to get drunk, which is more common than among adolescents in Europe on average. (Rimpelä et al. 1999, Hibell et al. 1998, Hibell et al. 2012.) Occasional drunkenness among Finnish adolescent may be a more acceptable drinking style than frequent alcohol consumption. Further, a possible explanation for the finding that the association between depression and substance use other than alcohol was stronger than the associations between depression and frequent alcohol use and drunkenness is that Finnish adolescents in general took drugs less than adolescents in many other European countries or in the USA (Rimpelä et al. 1999, Hibell et al. 1998), and this holds true for the time being, too (Hibell et al. 2012, ESPAD Group 2016). Although among Finnish adolescents the popular way to get drunk is to take medicines and alcohol together (Rimpelä et al. 1999, Ahlström 1999) illicit drug use represents more clearly a risk-taking behaviour that might be associated with depression.

Although depression among girls was more common than among boys, and there were differences in substance use patterns between boys and girls, the fact remains that the rate of depression increased apace with frequency of alcohol use and the number of substance use experiments among both boys and girls. This concurs with the findings of Egger et al. (1999).

There are mixed opinions on the relationship between depression and substance abuse. Depression could be both a result of (Brook et al. 2002, Jane-Llopis and Matytsina 2006) and a reason for (Sihvola et al. 2008) alcohol and substance use. While causal pathways differ across substance use disorders, there is evidence that alcohol is a causal factor for

depression (Jane-Llopis and Matytsina 2006). It has also been suggested that the presence of major depression or alcohol use disorder doubles the risks of the second disorder and further causal association between alcohol use disorder and major depression is one in which alcohol use disorder increases the risk of major depression, rather than vice versa (Boden and Fergusson 2011). Of course, there may be common social and psychological factors behind depression and substance use and these factors can cause both depression and substance use. Associations between depression and substance use may be mediated by personality traits. High sensation seeking in adolescence is associated with engagement in risk-taking behaviours, especially substance use (Pedersen 1991, Bekman et al. 2010, Ortin et al. 2012), and on the other hand personality traits (e.g. increased self-criticism) predict increases in depressive symptoms (Kopala-Sibley et al. 2015).

It is known that depressive disorders usually manifest after the onset of other psychiatric disorders, but depression also increases the risk of the development of other psychiatric disorders such as substance abuse disorders. (AACAP 2007.) According to clinical studies depression seems mainly to be a withdrawal symptom and a consequence of alcohol use (Bukstein et al. 1992, Hovens 1993). Gender differences have been found. Deykin et al. (1992) in their study on a clinical sample found that onset of depression followed substance use dependence in males twice likely as in females, whereas depression was the primary disorder or its onset was simultaneous with substance use dependence among females. Owing to the cross-sectional study design, no causal connection between depression and drinking can be established in this study.

Experimenting with different things is a part of adolescence. Even if some proportion of alcohol consumption and experiments with substances may be a part of normative adolescent development, it is important to note the association of substance use with depression. It is suggested that higher adolescent alcohol use, even at subclinical levels, is associated with an increased risk of later problems with depression (Edwards et al. 2014). Early onset of drinking correlates with the frequency of any drinking and the frequency of binge drinking in middle adolescence (Morean et al. 2014) and is associated with problems with alcohol, including dependence and abuse of other substances in young adulthood (Brook et al. 2002). Early drunkenness is also a strong predictor of such problem behaviours as smoking, cannabis taking, sustaining injuries, getting into fights, and low academic performance (Kuntsche et al. 2013). Adolescent alcohol use disorders are not benign conditions that resolve over time (Rohde et al. 2001). Drug taking itself has been found to be significantly related to substance use disorders (Brook et al. 2002) and early onset of substance use is a robust predictor of future substance use disorders (Grant and Dawson 1998). Depression may be missed if the primary reported problem is substance abuse (Thapar et al. 2010). Substance use and depression often co-occur, complicating the treatment of both substance use and depression (Schuler et al. 2015). On the other hand it has been suggested that treating of adolescent psychiatric disorders often helps to alleviate the substance use disorder as well (Deas et al. 2006), and intervening in earlier-onset

depressive symptomatology may lead to a subsequent reduction in adolescent substance use (Maslowski et al. 2014).

An important goal of health education, preventive and self-help interventions for depression could further be to reduce substance use. (Cairns et al. 2014).

6.2 Associations between suicidal ideation and alcohol and substance use

The significant association between depressive symptomatology and suicidal behaviour in community samples of adolescents is well known (Kashani et al. 1989, Garrison 1989, de Man 1999). Suicidal ideation and attempts are also more prevalent in drug addicted than in other adolescents (Felts et al. 1992). Depression and substance use have been reported strongly associated in clinical (Bukstein et al. 1992, Fergusson et al. 1993, Hovens et al. 1993) and population studies (Rohde et al. 1996). Comorbid depressive disorders may partly explain the association between substance use and suicidal ideation and suicidal behaviours. Prior to Study II the association between suicidal ideation and substance use among adolescents had been predominantly documented in clinical datasets. There are still few population studies investigating whether drinking and use of substances other than alcohol are independently associated with severe suicidal ideation among adolescents. The present study (II) focused specifically on this topic.

The results of the present study (II) supported at population level that in middle adolescence frequent alcohol use, drunkenness and substance use other than alcohol indicate a risk of severe suicidal ideation independently of depressive symptoms. Such an association had previously been suggested in clinical studies and in selected adolescent population samples (Felts et al. 1992, Deykin and Buka 1994). After controlling for depressive symptoms and age, frequent alcohol use, drunkenness and substance use other than alcohol were associated with severe suicidal ideation in both sexes, when tested separately. The only difference detected was that frequent alcohol use (once a week) persisted in all analyses as a risk factor for severe suicidal ideation among boys, but among girls only when confounders were not controlled for. Use of substances other than alcohol was similarly a risk factor for severe suicidal ideation in both sexes. The results suggested that the association with suicidal ideation was more pronounced with the use of substances other than alcohol. Even occasional use of substances other than alcohol was associated with severe suicidal ideation among both boys and girls. Use of substances other than alcohol over 5 times increased the likelihood for severe suicidal ideation almost three fold among girls and over seven fold among boys compared to adolescents without experimentations with substances. Among boys this association seemed to be dose-related. This is in line with the later findings of Wong et al. (2013), who reported that especially taking heroin, but also taking cocaine, ecstasy, hallucinogens and inhalants, was associated with suicidal ideation, suicide plan and suicide attempts. These findings might be interpreted in the same way as the interpretation of the association of illicit drug taking with depression;

illicit drug taking is more clearly deviant and norm-breaking behaviour than drinking to get drunk, and it may therefore represent more obviously risk-taking behaviour associated with suicidal behaviour including suicidal ideation. The associations between suicidal ideation, depression and substance use are complex. Alcohol use increases the risk of suicidal ideation and suicidal ideation increases the risk of illicit drug taking (Zhang and Wu 2014). Illegal substance use can lead to suicidal thoughts and actions (Gart and Kelly 2015) and substance use may facilitate the transition from suicidal ideation to suicidal behaviour (Bridge et al. 2006). Ortin et al. (2012) suggested that high sensation seeking is positively associated with depressive symptoms and substance use problems and the main effects of sensation seeking on suicidal ideation and suicide attempts remained significant after controlling for depression and substance use. The cross-sectional design of the study (II) did not permit conclusions on the causality, but the findings nevertheless emphasized the importance of recognizing substance use as a risk factor and early warning signal for suicidality in adolescence.

Due to variations in the definitions, sample characteristics and to a lack of accurate statistics, the prevalence rates of suicidal ideation are difficult to estimate (Pelkonen et al. 2011). Severe suicidal ideation was reported by 2.3% of the present sample. This is not as much as that observed in some other population studies (Smith and Crawford 1986, Harkavy Friedman et al. 1987, McKeown et al. 1998), and contrast the findings of many other studies (Garrison et al. 1993, Andrews and Lewinsohn 1992, McKeown et al. 1998), there were no significant differences in severe suicidal ideation rates between boys and girls in this study (II). An explanation for this may be the strict definition of suicidal ideation in the present study (II). It is known that females report physical and mental health problems much more than males (Riska 2011). Mild suicidal ideation may be more common among girls than among boys.

The findings confirm the importance of routine screening for substance use in the assessment of adolescent suicide risk (Zhang and Wu 2014). Despite its high prevalence and known risk factors, suicidal behaviour in many children and adolescents often goes undetected by parents, teachers and health care providers (Horowitz et al. 2009, Pelkonen et al. 2011). Adolescent suicidality is undertreated (Fitzpatrick et al. 2012). Recognition and effective treatment of psychiatric disorders, e.g. depression are essential in preventing adolescent suicides (Pelkonen et al. 2011).

6.3 Trends in adolescent depression

There are inconsistent findings on the trends of adolescent depression. Some studies (Costello et al. 2006, Richter et al. 2008) suggest that there has been no evidence of increase in depressive disorders over the past 30 years. Some older studies (Birmaher et al. 1996, Fombonne 1998a), however, suggest an increase in prevalence and a decrease in age at the onset of depression. There are only a limited number of studies on depression trends among

families with different socio-economic backgrounds, and a problem in many earlier time trend studies on adolescent depression is that they have not used comparable measurement instruments. The present study addressed this gap in the research. The large dataset of the present study (III, IV) enabled the examination of depression trends in different socio-economic groups.

The present study showed a clear increasing trend in severe depression over time among boys and girls with disadvantaged socio-economic backgrounds. The prevalence of severe depression among adolescents whose parents had a low level of education and who were unemployed nearly doubled from the beginning of the study and was ten times higher among boys and three times higher among girls compared to boys and girls whose parents had a medium or high level of education and were employed in 2010-2011. Otherwise, the present study (III) showed overall rather small changes in the occurrence of depression during the study period. When examining the full sample, among girls the rate of severe depression was slightly higher in the beginning of the second decade of this century (2010) than in the beginning of the first decade (2000). The increasing trend in severe depression among socio-economically disadvantaged adolescents concurs with the findings of Sigfusdottir et al. (2008) from Iceland and Sourander et al. (2008) from Finland, but differs from the findings of the meta-analysis by Costello et al. (2006). Those studies, however did not investigate the effect of socio-economic background on depression trends.

The findings of the present study (III, IV) suggest that mental health inequalities have increased among Finnish adolescents during the first decade of the 2000s and economic inequality is associated with increasing mental health inequalities. Depression was more common among girls than among boys in all socio-economic groups, with the exception of the most disadvantaged group (parents with low level of education and unemployed), in which severe depression was more common among boys than among girls. This finding suggests that socio-economic disadvantage may be a more powerful risk factor of depression in boys than in girls.

6.4 Trends in adolescent alcohol use

Many factors affect changes in the prevalence of alcohol consumption, including income, marketing, prevention strategies, changes in adult prevalence, shifts in adolescent culture, and so on (Simons-Morton et al. 2009). Alcohol use has decreased among adolescents in many Western countries and adolescents' and their parents' attitudes toward drunkenness have become stricter (Kinnunen et al. 2015). The price and availability of alcohol also have a major impact on underage alcohol use. The price of alcoholic beverages in Finland has risen due to tax increases in recent years. At the same time total alcohol consumption has decreased in Finland (THL 2017). The availability of alcohol has also become more difficult due to stricter control of sales of alcohol to minors in Finland (Lintonen et al. 2013).

The large amount of data made it possible to study trends in adolescent alcohol use according to socio-economic background and depression among both boys and girls. Apparently no time trend studies on adolescent alcohol consumption have so far investigated the role of depression.

One of the main findings of the present study is that, contrary to the decreasing trends in the full sample, frequent alcohol use and drunkenness actually increased over time among adolescents who were depressed and whose parents had a low level of education and who were unemployed. These adolescents displayed more unfavourable patterns in their alcohol consumption at the beginning of the study, and the difference between these adolescents and the more advantaged adolescents increased throughout the study period.

The general trend of declining alcohol use found in the present study (IV) is in line with the findings of earlier studies from the USA, the UK, New Zealand, and Finland by Gruzca et al. (2009), Healey et al. (2014), Clark et al. (2013), and Lintonen et al. (2013) and Kinnunen et al. (2015) respectively. However, it differs from the findings in the Netherlands by de Looze et al. (2014). According to the ESPAD Study (ESPAD Group 2016) use of alcohol among European adolescents decreased between 2003 and 2015 and no gender differences in trends could be observed, with the exception of constantly higher rates among boys. Further, the decreasing trend in adolescent alcohol use was especially strong in the Nordic countries. The findings of the present study concur with these findings.

The rates of frequent alcohol use and drunkenness among boys were higher than those among girls regardless of SES; however, these differences between the genders diminished over the twelve-year follow up. This finding concurs with those of Simons-Morton et al. (2009) and Lampert et al. (2014). The rates of frequent alcohol use and drunkenness were higher among adolescents whose parents were unemployed than among those whose parents were employed. This finding differs from the findings of Piko and Fitzpatrick (2007), who showed that the adolescents whose parents were unemployed were less likely to report alcohol use. Similarly frequent alcohol use and drunkenness were more common among adolescents whose parents had a low level of education than among adolescents whose parents were better educated. The results of the present study (IV) concur with earlier findings (Piko and Fitzpatrick 2007, Melotti et al. 2013) showing an inverse relation between adolescents' parental educational levels and their alcohol use; however, Bellis et al. (2007) and Sanchez et al. (2013) measured SES as disposable family income and obtained different results.

Parents' low level of education, unemployment and especially adolescent depression dramatically increased adolescents' frequent alcohol use and drunkenness. It is known that adolescent depression is more common among socioeconomically disadvantaged groups (Tracy et al. 2008, Najman et al. 2010), and depression itself is associated with increased alcohol use and drunkenness (Boden and Fergusson 2011). In addition to this, the results of the present study (IV) showed that the rates of frequent alcohol use and drunkenness among the most disadvantaged group increased at the same time as they decreased among

the more advantaged group. The greater difference in frequent alcohol use and drunkenness between the groups both among boys and girls reflects the increased SES-related gap. More research is needed on why these differences are increasing.

The general decline in adolescent alcohol consumption and drunkenness may be due in part to changes in alcohol policies, restrictions on the availability of alcohol and intensified efforts aimed especially at adolescents (Cruzza et al. 2009, Simons-Morton et al. 2009, Clark et al. 2013, Lintonen et al. 2013). One explanation for the differences in trends in alcohol use found in this study could be the ineffectiveness of policies and preventive programmes targeting disadvantaged adolescents suffering from depression. Due to social isolation, exclusion, other individual traits or because their parents may have fewer resources to encourage healthy attitudes and behaviours, policies and programmes may be less efficacious with such young people. More research on the effectiveness of preventive programmes is needed.

6.5 Impact of parental education and employment on adolescent depression and alcohol use

Low family income and socio-economic status (Piko and Fitzpatrick 2007, Lemstra et al. 2008, Tracy et al. 2008) are risk factors for adolescent depression. The material factors effect health mainly through the mediating factors that are linked to an uneven distribution of the available financial resources (Laaksonen 2011).

High family SES may exert diverse influences on adolescent alcohol-use patterns. On the one hand, the higher disposable income may enable adolescents to acquire and consume alcohol more (Bellis et al. 2007, Sanchez et al. 2013). On the other hand, well-educated parents may encourage their children to adopt healthy lifestyles and avoid alcohol (Melotti et al. 2013). Further, less educated and unemployed parents may also have fewer resources to supervise their adolescents than those in more fortunate circumstances. Adolescents with a socioeconomically unfavourable background are likely exposed to adversities such as parental psychological problems and substance use (Melotti et al. 2013), which in turn may predispose them to substance use. However, the potential psychological problems or substance use of parents were not investigated in the present study.

Poverty, exclusion from the labour market, and low levels of education are often greatest among the same populations (Ministry of Social Affairs and Health, Finland 2013). The low level of education mainly only allows access to low-paid jobs, and unskilled workers are often at risk of becoming unemployed. Unemployment is a major cause of low income, poverty and exclusion (Martikainen and Mäki 2011). Finland's low child poverty increased in the 2000s, although the increase was steeper in the late 1990s (Sauli et al. 2011). Child poverty is most common in unemployed and low-paid single parent families. Further according to Metteri (2012), the individualism emphasized by neo-liberal doctrines appears

to have been incorporated into Finland's welfare policy, and disadvantaged individuals who depend on basic social security are victims of this welfare policy change. Relative poverty seems to be increasing, and attitudes towards the socioeconomically disadvantaged are becoming less and less compassionate (Metteri 2012). The above mentioned changes may lead to increasing levels of distress associated with socioeconomic disadvantage, which in turn may explain the increase in rates of depression among adolescents whose parents are low educated and unemployed. Increasing frequent alcohol use and drunkenness may be their way of trying to cope with or self-medicate against distress; the distress associated with socio-economic disadvantage may increase, and motivation to cease unhealthy behaviours such as alcohol use may decrease when attitudinal climate changes become stricter, perhaps even leading to adolescents' educational and social exclusion.

Depression was more common among girls than among boys in all socio-economic groups, with the exception of the most disadvantaged (parents with low level of education and unemployed), in which severe depression was more common among boys than among girls. This finding suggests that socioeconomic disadvantage might be a more powerful risk factor for boys than for girls. It has been suggested that lack of social support from peers is a greater risk for depression among boys than among girls (Rubin 1992). It is obvious that boys from disadvantaged family backgrounds do not have the same financial opportunities for hobbies and other social activities as boys from more affluent family backgrounds and through these activities to make friends and gain peer approval and support. Further, it is known that adolescents who are bullied and those who are bullies are at an increased risk of depression (Kaltiala-Heino et al. 1999a). High rates of depression among disadvantaged adolescents may partly be explained by bullying. It might be that bullying and being bullied are more common among adolescents from disadvantaged family backgrounds than among adolescents from more affluent family backgrounds.

Academic achievement and school performance were not assessed in the present study. Nevertheless it can be stated that mental health and academic achievement are reciprocally related. School failure affects mental health in the form of increased internalizing and externalizing behaviour problems (Gustavsson et al. 2012) and mental disorders such as depression and substance use have negative effects on academic achievement (Thapar et al. 2012, Latvala et al. 2014, Silins et al. 2015).

Studies also show a relation between academic achievement and the positive aspects of mental health (Gustavsson et al. 2012). While some adolescents develop mental health problems as a function of adversity, many adolescents do not. More studies are badly needed on why some individuals manage to keep mental health despite suffering severe adversity.

The results of the present study (III, IV) indicate increasing mental health disparities among adolescents. Reducing health inequalities likely requires societal action. More effective recognition and treatment of depression seems warranted in order to reduce adolescent alcohol use. Systematic use of screening questionnaires and screening interviews would facilitate the recognition of depression. School health and welfare services and

primary healthcare should develop skills and strategies to motivate and support different adolescent groups to reduce their alcohol consumption.

6.6 Methodological considerations

All studies (I, II, III and IV) were carried out in the 8th and 9th grades of comprehensive schools. Attending the nine year comprehensive school education is obligatory until age 16 in Finland, and in practice, all children and adolescents (>99%) do fulfil this obligation. The data of Studies I and II comprise the responses of comprehensive school pupils in two regions of Finland (Vaasa and Tampere) where almost all schools participated (113 schools). Studies III and IV used a nationwide, population-based dataset with high participation, resulting in a large and representative sample of 14- to 16-year-old Finns enabling the study of temporal trends. The 535 schools which participated in every survey were located across the country and thus represented both urban and rural populations in Finland. Finland is a very homogenous country, and in 2011, little polarization of school districts resulting in socially different schools could be seen (OECD 2010). The measurements of alcohol use and depression, study timing and sampling were similar for each study year, and the surveys were conducted using the same method within the same schools throughout Studies III and IV. Thus the surveys are as comparable as possible.

Population surveys provide information on those adolescents whom health care system does not reach. A shortcoming of these studies is the fact that not all respond and it is likely to be the non-respondents who suffer from problems more often than respondents (Kaltiala-Heino et al. 2015, Kekkonen 2016). Depression screening measures (symptom self-reports) do not diagnose depression, because they do not address important diagnostic features such as duration of symptoms, degree of impairment and comorbid psychiatric disorders (Sharp and Lipsky 2001). Moreover, the depression rating scale used most often with adolescents, the BDI (Myers and Winters 2002), measures respondents' perceptions of their own depressive symptoms, but it is not a diagnostic instrument for depressive disorders. However, severe symptoms of depression in adolescents are likely to be relatively persistent (Charman 1994) and most of the morbidity associated with depression comes from the numerous people with depressive symptoms rather than the few cases with depressive disorder (Harrington and Clark 1998). Furthermore, Lewinsohn et al. (1994) argued that symptoms of depression are usually better predictors of depressive disorder than other risk factors. To avoid bias due to the normal mood changes during adolescence, the depression score (R-BDI) was dichotomized to moderately or severely depressed versus no depression or mildly depressed in Studies I and II. In Study IV the analyses were focused on severe depression determined using the R-BDI.

Transient death wishes and nonspecific suicidal ideation are relatively common in adolescence (Reinherz et al. 1995). Therefore in Study I, suicidal ideation was dichotomized to severe suicidal ideation (with a plan) versus no suicidal ideation or having only death

wishes in Study II. The prevalence rates of suicidal ideation vary widely between studies due to different methods for measuring suicidal ideation. Owing to the strict definition of suicidal ideation in this study, the prevalence rate of suicidal ideation was lower than that reported in some other population studies (Harkavy Friedman et al. 1987, McKeown et al. 1998, Gmitrowich et al. 2003, Husky et al. 2012, Consoli et al. 2013, Sampasa-Kanyinga et al. 2015, Cluver et al. 2015). Despite the different prevalence rates of suicidal ideation founded in the study, it is unlikely that the association between suicidal ideation and substance use would change.

The estimation of substance use was based on adolescents' self-reported frequency of drinking, drunkenness and other substance use, but there were no estimations of the quantities consumed. Moreover the age of onset of alcohol consumption and use of other substances than alcohol were not elicited.

Adolescents rarely have substance use disorders fulfilling the diagnostic criteria of dependence. Therefore it is reasonable to focus on substance use patterns (Kaltiala-Heino et al. 2015). A valid method to study adolescents' harmful alcohol consumption is to elicit adolescents' experience of being drunk. Such experiences can be measured by asking if an adolescent has ever drunk so much alcohol as to be really drunk and how often he or she has been really drunk. It is suggested that self-reported drunkenness relates logically to the amounts of alcohol consumed in adolescence (Lintonen et al. 2004).

The studies have limitations in reliability and accuracy such as are inherent in self-reported data on alcohol use; self-reports may contain exaggerations or underreporting based what the adolescents perceive to be socially desirable. People tend to underreport their drinking, and they may not recall the amounts consumed correctly (Ekholm et al. 2011). Therefore, the findings of the present study may underestimate the actual amounts of alcohol consumed. However, even possible under- or over-reporting may not systemically bias the assessment of the observed associations or trends. Furthermore, research has shown that self-reports of substance abuse are the most valid measure (Lintonen et al. 2004), and other studies using different methods have shown decreasing trends in alcohol use among Finnish adolescents (Lintonen et al. 2013, ESPAD Group 2016).

Information on how many per cent of the schools participated in the studies biennially remained unavailable. However, the data were uniquely large, with 618,048 participants, and each biennial cohort ($n=94,635-108,320$) covered more than 75% of the whole age cohort in the country.

A further limitation of this study is that those absent from school on the survey day were lost to data collection. Approximately 10%–15% of adolescents in comprehensive schools in Finland are absent from school on any given day (Kaltiala-Heino et al. 2001).

Alcohol use and depression may be more common among those adolescents who were absent from school on the day of the survey. Therefore, the including of these individuals might have resulted in somewhat higher outcome rates. However, even high levels of attrition may not necessarily affect the associations studied in health surveys (Van Loon et al. 2003).

7 SUMMARY AND CONCLUSIONS

Even if adolescence is a time of various experimentations, including experimentations with alcohol and other substances, it is important to note the association of substance use with depression, given that especially adolescents with co-occurring depression and substance use are at increased risk for social and personal impairment as well as other psychiatric conditions in adolescence and later in adulthood.

Depression is increasing among adolescents with a socio-economically disadvantaged background. The finding that depression was more common among girls than among boys in all socio-economic groups, with the exception of the most disadvantaged (parents with low level of education and unemployed), in which severe depression was more common among boys than among girls, suggests that socio-economic disadvantage may be a more powerful risk factor of depression in boys than in girls.

In contrast to the general decreasing trend in adolescent alcohol use, frequent alcohol use and frequent drunkenness increased among socioeconomically disadvantaged adolescents with depression during the study period. The findings of the present study suggest that mental health inequalities have increased among Finnish adolescents during the first decade of the 2000s and economic inequality is associated with increasing mental health inequalities.

Frequent alcohol use and use of substances other than alcohol are associated with suicidal ideation among adolescents independent of depression. Suicide is a result of multiple factors, but substance use may be especially important in the development of suicidal and other self-destructive behaviours.

7.1 Clinical implications

Health care professionals have a special challenge to recognize depression among adolescents frequently consuming alcohol and using and substances other than alcohol, and for identifying risk of substance use among depressed adolescents. Co-operation between schools and health care professionals and parents is needed to improve the opportunities for early interventions.

There is a need to design assessment and intervention strategies to help adolescents with depression and substance use. Earlier research has shown that adolescents who are depressed and engage in substance use need more mental health services than adolescents with only depression or substance use. It is also suggested that the treatment of adolescent

psychiatric disorders often helps to alleviate the substance use disorder as well, and intervening earlier in incipient depressive symptomatology may later lead to a reduction in adolescent substance use.

More effective treatment of depression seems warranted in order to reduce adolescent alcohol consumption. This should include improving the identification of depression by systematic use of screening questionnaires and screening interviews and motivational interviewing in order to enhance treatment compliance and large-scale dissemination of evidence-based therapies for depression.

It is also important to keep suicidality in mind when assessing adolescents with substance use. School and health care professionals have a special challenge to identify suicidality in adolescents who drink heavily and use substances, whether or not they present with depression.

More support is needed to enhance healthy lifestyles among socioeconomically deprived adolescents compared with more privileged adolescents. At the individual level, school health and welfare services and primary healthcare should develop skills and strategies to motivate and support different adolescent groups to reduce their alcohol consumption. An important goal of health education, preventive and self-help interventions for depression could further be deployed to reduce substance use.

7.2 Implications for future research

Research on planning measures to reduce mental health inequalities is desperately needed, and information on trends in mental health inequalities provides a good foundation for this research.

Depression has increased among disadvantaged adolescents. More research is needed on this topic. Similarly, increasing alcohol consumption among socioeconomically disadvantaged depressed adolescents needs further study.

Depression is common among boys with disadvantaged family backgrounds and heavy alcohol use is observed especially among socio-economically deprived, depressed boys. It is possible that socio-economic disadvantage may be a more powerful risk factor for boys than for girls. Unfortunately, this does not appear to have been studied, and further research is needed to confirm this assumption.

Research on protective factors against suicide among substance using adolescents is needed.

An explanation for the differences in the trends in alcohol use found in this study could be the ineffectiveness of policies and preventive programmes targeting disadvantaged adolescents suffering from depression. More research is needed on the effectiveness of preventive programs.

While some adolescents develop mental health problems as a function of adversity, many adolescents do not. More studies are badly needed on why some individuals manage to keep mental health despite suffering severe adversity.

7.3 Policy implications

The goal, and the most difficult challenge of health policy, is to reduce inequality gaps. The results of the present study suggest that mental health inequalities have increased among adolescents in Finland during the first decade of the 2000s and that the health policy goals to reduce these inequalities have not been achieved. Reducing health inequalities likely requires societal action. Targeting preventive efforts at disadvantaged adolescents and improving the living conditions of families might be useful in reducing the burden of depression and reducing alcohol and other substance use.

Finland is a very homogenous country, and in 2011, little polarization of school districts resulting in socially different schools could be seen. The Finnish municipalities have been forced to reduce educational resources due to financial constraints. It is difficult to assess the impact of the decreased educational resources on pupils' mental health. However, it may be that the risk of educational and social exclusion among adolescents will increase if the education of adolescents with special needs is not sufficiently provided for.

8 ACKNOWLEDGEMENTS

This study was carried out at the University of Tampere, School of Public Health and Kanta-Häme Central Hospital, Department of Psychiatry. This work was financially supported by the Competitive Research Fund of Pirkanmaa Hospital District and by the Competitive Research Fund of Kanta-Häme Central Hospital.

I owe my sincere gratitude to my supervisors: Professor Riittakerttu Kaltiala-Heino and Professor Arja Rimpelä for teaching me psychiatric research. They have given me very valuable support and advice during this study process. Without their patient guidance and inspiring encouragement this study would never have been completed.

I am deeply grateful to Professor Päivi Rantanen, who encouraged me to start this study and was my first supervisor. I also wish to thank her for co-authorship in two of the articles.

I want to express my warmest thanks to the members of the follow-up group, Professor Matti Rimpelä and Professor Mauri Marttunen for their invaluable support and for co-authoring articles. I also warmly thank Tiina Luukkaala M.Sc. for co-authorship in two of the articles and for helping me with statistical problems.

I wish to express my profound gratitude to the official reviewers of this study, Docent Laura Kestilä and Docent Kaisa Riala, for providing me with valuable and constructive comments for improving this dissertation.

I warmly thank the members of research team of the Social Psychiatry Unit, especially Teaching Coordinator Helena Rantanen for providing me for the facilities of the institution at the beginning of my research career. I warmly thank Mr. Jukka Jokela of the National Institute for Health and Welfare, who kindly provided the data necessary for the analyses. Mrs. Virginia Mattila revised the language of the study and I owe her my grateful thanks.

And finally, I owe my special thanks to my wife Päivikki who always has believed that I would one day bring this project to a successful conclusion.

Hämeenlinna 2017

Antti Torikka

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10 ORIGINAL PUBLICATIONS

