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ADOLESCENT ADHD AND FAMILY ENVIRONMENT—AN EPIDEMIOLOGICAL AND CLINICAL STUDY OF ADHD IN THE NORTHERN FINLAND 1986 BIRTH COHORT

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Abstract

The primary aim of this study was to survey attention and behavioural problems among Finnish adolescents living in different family environments. The second aim was to study the psychosocial well-being of these adolescents. The third aim was to study the psychiatric comorbidity of ADHD (attention deficit hyperactivity disorder) in association with the family environment. The fourth aim was to study the persistence of ADHD from childhood to adolescence.

In the first phase, 15-year-old adolescents and their parents from the Northern Finland 1986 Birth Cohort (N = 9432) completed questionnaires on attention and behavioural problems, family characteristics and the life situation of the adolescents. In the second phase, 457 adolescents aged from 16 to 18 years were drawn from the cohort. After assessment with a clinical semi-structured interview, logistic regression models were used to study ADHD and the persistence of the diagnosis and comorbid psychopathology in association with family characteristics.

Girls reported more commonly than boys attention and behavioural problems, while their parents reported more attention problems in their sons than daughters. Living in other than intact families was related to attention and behavioural problems in both genders. Adolescents with ADHD symptoms considered their physical health and psychosocial well-being poor more often than their controls. Psychosocial problems accumulated for those with many ADHD symptoms. Adolescents with ADHD had more commonly than others comorbid behavioural disorder, alcohol abuse and depression. Those with ADHD and comorbidity lived more commonly than others in non-intact families, in low-income families, with mothers who were dissatisfied with life and with parents who showed little interest in their adolescent's activities. Persistence of ADHD into adolescence occurred in about two thirds of cases. Those who persisted with the diagnosis compared to those who remitted it had more dreamy-like inattentive symptoms, and had more often early-onset comorbid depression or oppositional defiant disorder and had more often fathers with attention problems.

These results indicate that attention and behavioural problems are common among adolescents in Finland, especially among those living in disrupted families. Being a persistent disorder, ADHD warrants more concern in primary health care and the educational system in order to prevent the concurrent development of other psychiatric and psychosocial problems. In primary health care, family intervention is essential.

Keywords: ADHD, adolescent, attention deficit disorder with hyperactivity, attention problems, behavioural disorder, behavioural problems, birth cohort, cross-sectional studies, epidemiology, family characteristics
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Tiivistelmä


Nämä tulokset osoittavat, että tarkkaavuuden ja käyttäytymisen ongelmat ovat yleisiä suomalaissuoralla, ja erityisesti niillä, jotka asuivat muussa kuin ydineperheessä. Koska ADHD on pysyvä häiriö, se tulee ottaa paremmin huomioon perusterveydenhuollossa ja koululaailmassa, jotta voitaisiin ehkäistä muita psykiatrias ja psykososiaalisia ongelmia. Perusterveydenhuollossa erityisesti perheinterventiot ovat tärkeitä.

Asiasanat: ADHD, epidemiologia, käyttäytymisen ongelmat, käyttäytymishäiriö, nuoret, perheautta, poikittaistutkimus, syntymäkohortti, tarkkaavuuden ongelmat, tarkkaavuus-häiriö
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Oulu, April 2007

Tuula Hurtig
Abbreviations

ADHD  Attention-Deficit/Hyperactivity Disorder
CD    Conduct Disorder
CGAS  Children’s Global Assessment Scale (Shaffer et al. 1983)
chi2  chi-square
CI     confidence interval
DSM-IV The Diagnostic and Statistical Manual of Mental Disorders, IVth edition (American Psychiatric Association 1994)
MDD   Major Depressive Disorder
NFBC 1986 Northern Finland 1986 Birth Cohort
NOS   not otherwise specified
ODD   Oppositional Defiant Disorder
OR    odds ratio
p, p-value significance probability
SCT items sluggish cognitive tempo items
SWAN The Strengths and Weaknesses of ADHD Symptoms and Normal Behaviors (Swanson et al. 2001)
List of original publications

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


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1 Introduction

Attention disorders, such as attention deficit hyperactivity disorder (ADHD), are common mental disorders among children and adolescents. As a neuropsychiatric disorder, ADHD is characterized by symptoms of inattention, hyperactivity and impulsivity with neurocognitive deficits in response inhibition, attention span and memory. Comorbid behavioural disorders are often diagnosed in clinic-referred children and adolescents with ADHD.

Teachers have reported an increase of various attention and behavioural problems among children and adolescents during the recent years in Finland (Opettajalehti 2005). Obviously, these problems are due to several reasons, e.g. lack of sleep, unhealthy eating habits or problems in family life which may manifest as attention problems at school. However, the quality of the family environment may be related to the onset of attention disorders, as the classic studies of Rutter revealed a link between the child’s family environment and his or her mental health (Rutter et al. 1975).

Although there are some epidemiological studies on the psychiatric symptoms of young children and their family environment (e.g. Luoma et al. 1999), the relationship between attention disorders in adolescents and family environment has not been studied before in Finland. Moreover, it is unknown what circumstances cause children with ADHD to develop comorbid behavioural disorders in adolescence. The purpose of this work was to provide information about ADHD among adolescents in Northern Finland. The author of this thesis aimed to find out the associations between ADHD, behavioural disorders and family environment. Although basic research, this work also aims to benefit practical work and to give ideas for future research. Teachers, school nurses and social workers lack information and practical guidelines for how to deal with students with attention problems and their families. They feel concerned especially for adolescents with comorbid attention and behavioural problems, who, at the delicate point of life when leaving compulsory school and making decisions about their future education and career, are at risk for dropping out from the social networks of the community if they do not receive support.

This thesis utilises both epidemiological and clinical research designs. Epidemiology deals with the symptoms of various diseases and disorders and the estimated prevalence of such disorders is studied in the general population. The clinical research design utilises
direct interviews to make clinical diagnoses. This research project used the Northern Finland 1986 Birth Cohort (NFBC 1986) as a study population. The NFBC 1986 consists of an unselected general population based on a prospective mother-child birth cohort of 9432 live births between 1st July 1985 and 30th June 1986 in the two northernmost provinces of Finland, Oulu and Lapland (Järvelin et al. 1993). Information about the attention and behavioural problems and the life situation of the adolescents in this population was obtained with a questionnaire-based survey conducted among adolescents and their parents. For the clinical part of this study a sample of adolescents with and without attention problems was drawn from the cohort and invited to a clinical examination. The data collection process was a part of the NFBC 1986 ADHD project focusing on molecular genetics, which was started in 2001 in collaboration with the University of Oulu and the University of California, Los Angeles.

In this thesis, the attention and behavioural disorders of adolescents were studied in relation to their family environment. The family environment of children and adolescents in Finland is rapidly changing because of rising divorce rates. Also, the increasing demands of working life may place parents into stressful situations both at work and at home. Factors of this kind may affect the mental health of the offspring.
2 Review of the literature

2.1 ADHD as a neuropsychiatric disorder

2.1.1 History and diagnosis of attention disorders

The first scientific descriptions of ADHD-like symptoms in children are from the beginning of the 20th century. Still described in his case reports intellectually normal children who had problems in inhibitory control, or in “moral control” according to the contemporary terminology (Still 1902a). He also pointed out that many of these children had subnormal capacity for sustained attention (Still 1902b). It was also noticed from the very beginning that certain physical conditions, such as encephalitis or head injuries may damage certain regions of the brain and result in hyperactivity in children (e.g. Blau 1938, Strecker & Ebaugh 1924). Deficits in attention or hyperactivity were thus considered neuropsychiatric symptoms since the beginning. From the 1950s to the 1980s, the terms “minimal brain damage” or “minimal brain dysfunction” (MBD) were used to describe children with hyperactivity symptoms. However, organic brain damage or dysfunction was only present in a small proportion of hyperactive children, and such brain damage was found to be associated with an increase in the risk of other psychiatric disorders (Rutter 1981).

During the past decades, other biological factors have also been connected with ADHD behaviours, including lead poisoning and food additives. In the 1970s, David et al. (1977) found higher lead concentrations in hyperactive children than in control children, but the underlying mechanisms remained unclear. Lead poisoning has been found to be associated with low IQ and behavioural disturbances (e.g. Winneke 1983). The findings of David et al. were not replicated, however. Also in the 1970s, Feingold (1975) suggested that certain food additives may be related to hyperactivity in children. Subsequent double-blind trials failed to replicate his findings (e.g. Taylor et al. 1991, Harley et al. 1978).

The diagnostic term has varied from MBD to DAMP (deficits in attention, motor control and perception) or ADD (attention deficit disorder) with or without hyperactivity.
or hyperkinetic disorders. The concept of DAMP is still, however, occasionally used in clinical work, especially in Sweden. The diagnosis of DAMP may include, in addition to ADHD behaviours, also developmental and learning difficulties and autistic type behaviours (Gillberg 2003). The diagnosis of DAMP thus applies to a small clinical group of children with severe ADHD behaviours and multiple needs. Today, however, the focus is on deficits in sustaining attention, and attention deficit hyperactivity disorder (ADHD) is the most commonly used term in both clinical and research work.

The focus and methodology of ADHD research have also varied during the recent decades. Studies on family environment and other social factors related to ADHD were mainly done in the 1970’s and 1980’s (e.g. Hechtman et al. 1984, 1981, Rutter et al. 1975), while genetic studies were the main topic in the 1990’s (e.g. Faraone et al. 1994). In the 2000’s, research has expanded to study the gene-environment interactions related to ADHD (see the review by Thapar et al. 2005).

Today, the diagnosis of attention disorders still varies, depending on the diagnostic criteria. The diagnostic criteria mainly used in Europe, International Classification of Diseases (10th edition, ICD-10, World Health Organization 1993), describe a hyperkinetic disorder (HKD), whereas the American criteria, Diagnostic and Statistical Manual of Mental Disorders (4th edition, DSM-IV, American Psychiatric Association 1994) describe an attention deficit hyperactivity disorder (ADHD). Both classifications require symptoms of inattention, hyperactivity or impulsivity to be present in at least two settings, e.g. at home, at school or in social relations. DSM-IV also requires functional impairment, though ICD-10 does not. ICD-10 is, however, more restrictive, because it requires more symptoms (six out of eight inattentive symptoms, three out of five hyperactive symptoms and one out of four impulsive symptoms) to be present for a diagnosis than DSM-IV, which requires six out of nine inattentive symptoms or six out of nine hyperactive-impulsive symptoms or six of both symptoms. ICD-10 also requires all the symptoms to be present by the age of 7 (World Health Organization 1993) while DSM-IV requires the presence of at least some impairing symptoms prior to age 7 (American Psychiatric Association 1994).

The treatment of attention disorders with stimulant drugs began with some experiments in the 1930s and has been in common use since the 1960s in the Western world (Doyle 2004). Some non-stimulant drugs (e.g. atomoxetine and bupropion) have also been used. It was reported in the 1990s that stimulant treatment was increasing in the United States and in 1995 nearly 3% of all school-aged children received stimulants (mainly methylphenidate, Safer et al. 1996). In Finland, stimulant treatment is quite rare and the prescription of medication is carefully considered by a specialist (Erkolahi & Piha 1998). In the past decades, behavioural therapy, psychosocial and educational interventions and even diet therapy in addition to drugs have been part of the treatment. Nowadays, combined drug and behavioural treatment has been found most effective in the treatment of ADHD in children in the United States (MTA Cooperative Group 2004). In Finland, psychosocial and educational interventions are included in the treatment of ADHD.
Currently, ADHD is considered a complex, multifactorial disorder that is caused by the confluence of several different risk factors (genetic and environmental), each of which makes a small contribution to the individual’s increasing vulnerability to the disorder. The risk factors interact with each other and when an individual’s cumulative vulnerability exceeds the threshold, the ADHD phenotype emerges (Biederman & Faraone 2005). Family, twin, adoption and molecular studies suggest that 60-80% of the underlying risk or liability to develop ADHD is likely to be genetic in origin with environmental risk factors accounting for 20-40% of the liability (Thapar et al. 1999, Hudziak et al. 1998, Faraone et al. 1994).

For many decades, clinicians have recognised the familiality of ADHD symptoms. Consequently, heritability may play an important role in the etiology of the disorder and much of the research is thus focused on genetics. Molecular genetic studies using genome scans and linkage analysis have suggested chromosome regions where some susceptibility genes may reside (e.g. Ogdie et al. 2003, Bakker et al. 2003). Some of these genes are involved in dopamine transmission in brain and some in serotonergic transmission (Lowe et al. 2004, Hawi et al. 2003). Several studies have also assessed the association between the SNAP25-gene, which is involved in synaptic-vesicle transport and release, and ADHD (e.g. Arcos-Burgos et al. 2004).

The genes related to cerebral metabolism are now under study because neuroimaging studies have revealed dysfunction in dopamine transmission in the brains of individuals with ADHD. There are also other pathophysiological findings related to the diagnosis, such as a small volume reduction in the frontal-subcortical regions of the brain. (Faraone & Biederman 2004). This is likely to cause executive dysfunction in inhibition control, working memory, planning and sustaining attention, which are common neuropsychological findings among individuals with ADHD (e.g. Barkley et al. 2001, Miyake et al. 2000).

Environmental risk factors include biological and psychosocial adversity. Pregnancy and delivery complications, especially ones that lead to fetal hypoxia, such as toxaeemia, raise the risk for ADHD. Low birth weight, regardless of whether it is caused by prematurity, hypoxia or prenatal exposure to maternal alcohol use, is considered another independent risk factor for the disorder. (Saigal et al. 2003, Mick et al. 2002) Furthermore, there is powerful evidence of a relationship between maternal smoking during pregnancy and ADHD or hyperactivity in the offspring (e.g. see the review by Markussen-Linnet et al. 2003 and Kotimaa et al. 2003). Nicotine intake can damage the developing fetal brain by interfering with dopaminergic activity.

Psychosocial adversity as a cause for ADHD has been studied less than genetic and biological factors, although the relationship between the child’s family environment and his or her mental health has been a long-term topic of study. Rutter’s studies from the 1970s in the Isle of Wight and the inner borough of London revealed six adversity factors in the family environment that were associated with psychiatric symptoms in children: severe marital discord, low social class, large family size, paternal criminality, maternal mental disorder and foster placement (Rutter et al. 1975). The aggregate of these factors caused more deviance than any single factor alone. Rutter’s adversity factors have been
found to be associated with ADHD (Biederman et al. 2002, Scahill et al. 1999, Biederman et al. 1991) and behavioural disorders (Lahey et al. 1999, Loeber et al. 1995).

In accordance with Rutter, other studies suggest that living in a single-parent or reconstructed family increases the risk for mental problems in general (Taanila et al. 2004, Luoma et al. 1999, Garnefski & Diekstra 1997, Moilanen & Rantakallio 1988) and specifically ADHD (Barkley 1998). Biederman and colleagues also reported that chronic conflict and reduced family cohesion were more common in ADHD families than in control families (Biederman et al. 1995). But contrary to Rutter’s findings, large family size has been found a protective factor against behavioural problems in Finland (Taanila et al. 2004, Luoma et al. 1999).

### 2.1.3 Epidemiology of ADHD and behavioural disorders

In epidemiological research the estimated prevalence rates of attention disorders vary according to such factors as diagnostic threshold, informant, time frame and gender of subjects and naturally also the population under study. The DSM-IV diagnostic criteria for ADHD give somewhat higher prevalence rates than the rates for ICD-10 hyperkinetic disorder or the rates obtained by using the previous DSM-III criteria (Faraone et al. 2003b). Data from multiple informants may be difficult to combine because ADHD behaviours may be partly situational, i.e. teachers may notice more or different kinds of ADHD symptoms than parents. Cross-sectional studies have revealed the highest prevalence rates of ADHD among children in mid-childhood (6-9-years of age). Prevalence rates decrease in adolescence and adulthood. There is also a preponderance of males in the prevalence of ADHD. In epidemiological samples the male/female ratio is approximately 3:1. (American Psychiatric Association 1994)

In recent systematic reviews where parents and teachers were informants, ADHD prevalence estimates among school-aged children varied from 2% to 18% or from 5% to 10% (see the reviews by Rowland et al. 2002 and Scahill & Schwab-Stone 2000). Usually adolescents up to 18 years of age were included in these epidemiological surveys. In Finland, in studies on 8- to 9-year-old children, the prevalence rate for ADHD was estimated to be 7% (Almqvist et al. 1999). Adolescents have lower prevalence. According to adolescents’ self-reports, the ADHD prevalence estimates vary from 1.5% among older adolescents (Cuffe et al. 2001) to 5.8% among younger adolescents (Rohde et al. 1999). The range of prevalence rates of behavioural disorders reported by multiple informants is also wide: from 1.2% to 16% among children and adolescents (Loeber et al. 2000).

Generally, when adolescents report their mental problems girls in the United States and in Western Europe seem to report more emotional problems, such as depression or anxiety, and boys more attention and behavioural problems (e.g. Verhulst et al. 2003). Most studies on ADHD symptomatology are from the United States where boys (or their parents) report more ADHD symptoms than girls (Scahill & Schwab-Stone 2000). However, adolescent girls in the Nordic countries report more attention and behavioural problems than boys (Heyerdahl et al. 2004, Helstelä & Sourander 2001, Sourander et al. 1999). Overall, the highest rates of both behavioural and emotional problems are usually

It is also well known that children report different problems compared to their parents; children report more emotional problems, whereas adults tend to notice more behavioural problems. This has also been reported in a community sample in Finland (Puura et al. 1998). However, older children and adolescents seem to report more attention and behavioural problems than their parents (Muris & Meesters 2003, Sourander et al. 1999, Seiffge-Krenke & Kollmar 1998).

2.1.4 Characteristics of ADHD subtypes

ADHD is characterized by symptoms of inattention, hyperactivity and impulsivity. Because of the heterogeneity of symptoms in ADHD, three different subtypes are distinguished in the DSM-IV classification: the predominantly inattentive, the predominantly hyperactive-impulsive, and the combined type. The predominantly inattentive type is diagnosed if at least six of the nine inattentive symptoms are present, the predominantly hyperactive-impulsive type if at least six of the nine hyperactive-impulsive symptoms are present and the combined in the presence of at least six inattentive symptoms and six hyperactive-impulsive symptoms. (American Psychiatric Association 1994, see also table 2 in page 34 for symptoms of ADHD.) Though the inattentive and the combined types seem to be more prevalent than the hyperactive-impulsive type in community samples, there are temporal changes in proportional occurrence. The inattentive type seems to be more prevalent in adolescents and the hyperactive-impulsive type in children. (Biederman et al. 2002, Graetz et al. 2001, Nolan et al. 2001, Hudziak et al. 1998, Gaub & Carlson 1997, Wolraich et al. 1996.)

There is a growing body of literature about the differences in impairment between the subtypes (e.g. Weiss et al. 2003, Burns & Walsh 2002, Todd et al. 2002, Warner-Rogers 2000, Hudziak et al. 1998) indicating that children with the combined type tend to show the most severe impairment both in community samples (Graetz et al. 2001, Gaub & Carlson 1997) and in clinic-referred samples (Gadow et al. 2004, Hinshaw 2002, Faraone et al. 1998a). They also continue to have difficulties in young adulthood (Murphy et al. 2002). These findings raise two interesting questions: is the combined type the most severe subtype of ADHD and are the inattentive and hyperactive-impulsive symptoms similar in the combined type compared to the predominantly inattentive and hyperactive-impulsive types? Some studies report high correlations between the sluggish cognitive tempo (SCT) items (daydreaming, low in energy and drowsiness) and the inattentive subtype and even suggest that there may be two types of inattentiveness; one related to deficits in attention and the other related to dreamy-like symptoms (Todd et al. 2004, Carlson & Mann 2002, McBurnett et al. 2001).
2.1.5 Psychiatric comorbidity of ADHD

Comorbidity of ADHD has been one of the most actively studied topics in the field of child and adolescent psychiatry. Among clinic-referred children comorbidity is frequently found between ADHD and conduct disorder (CD) or oppositional defiant disorder (ODD) and between ADHD and depressive or anxiety disorders (e.g. Biederman & Faraone 2002). However, clinical samples may be over representative of, for instance, behavioural problems. These problems are frequently also seen in family members of the probands. It is unknown, however, whether family environment contributes to the risk for comorbid ADHD in the general population.

Comorbidity between ADHD and CD/ODD has been found in epidemiological studies as well (Scahill & Schwab-Stone 2000). Moreover, behavioural comorbidity is suggested to be genetically inherited and to constitute a distinct subgroup of ADHD in both genders (Banaschewski et al. 2003, Holmes et al. 2002, Nadder et al. 2002, Thapar et al. 2001, Faraone et al. 2000, Faraone et al. 1998b, Faraone et al. 1997). In clinic-referred samples, ADHD and comorbid CD appear to be related to greater ADHD symptom severity (Connor et al. 2003, Kuhne et al. 1997). These findings support the classification of hyperkinetic conduct disorder, as described in the ICD-10 (World Health Organization 1993), and raise the question about the potentially different etiologies of ADHD alone and ADHD with conduct/antisocial disorder. On the other hand, ADHD in childhood may be a risk factor for the onset of CD/ODD in adolescence. In their longitudinal community study among boys Taylor et al. (1996) found that hyperactivity symptoms in childhood predicted pervasive hyperactivity and conduct problems in adolescence.

Some studies among clinic-referred children suggest even other subgroups, such as ADHD with comorbid depressive (Mick et al. 2003) or anxiety disorders (Pliszka 1998). However, Ford et al. (2003) found in a large epidemiologic survey that the association between ADHD and depression disappeared when a third disorder (e.g. behavioural disorder) was controlled for. Symptoms of depression and anxiety may naturally overlap with some ADHD symptoms, e.g. poor concentration or restlessness, which may be symptoms of all these disorders. Consequently, ADHD may not be the primary disorder. There is also considerable overlap between ADHD and manic symptoms. However, ADHD and comorbid bipolar disorders are found quite seldom in the general population (e.g. Reich et al. 2005). It was also recognized long ago that individuals with autistic spectrum disorders often have ADHD-like symptoms. Goldstein & Schwebach (2004) suggested, based on their results, that ADHD may be a true disorder for a group of children with a pervasive developmental disorder.

Although there is evidence of a genetic component related to the onset of ADHD (e.g. Kustanovich et al. 2003), Burt et al. (2005), who studied twin pairs, pointed out that, although genetic and environmental factors were associated with both ADHD and behavioural disorders, the largest contributions to comorbid ADHD and CD/ODD were made by shared familial and contextual factors. Johnston and Mash (2001) concluded in their review of families of children with ADHD that ADHD in children is associated with e.g. disturbances in family, disrupted parent-child relationships, high levels of parenting stress and parental psychopathology, especially when ADHD is comorbid with conduct problems. However, there are only a few studies that have investigated the relationship
between ADHD and comorbid behavioural disorder and family environment. Barkley et al. (1992) compared two groups of clinic-referred adolescents, those with ADHD alone and those with ADHD and ODD to a community control group. They found that adolescents with ADHD and ODD reported more conflicts at home than those in the control group while their mothers reported more negative interaction, greater personal distress and less marital satisfaction than the control mothers. The ADHD alone group did not differ significantly from the control group in most measures. These findings have not been replicated in the general population.

The DSM-IV (American Psychiatric Association 1994) considers ADHD a dichotomous disorder, while some papers (El-Sayed et al. 2003, Scahill et al. 1999, Levy et al. 1997) discuss ADHD as a continuum with severe ADHD symptoms and impairment at one end and no ADHD symptoms at the other. Therefore, comorbidity of ADHD may also be related to the symptom severity of ADHD in the general population.

### 2.1.6 Temporal dimension of ADHD symptoms

According to the current opinion, ADHD has its onset in early childhood, and the disorder often persists into adolescence and adulthood (Costello et al. 2003, Wilens et al. 2002, Biederman et al. 1996). According to follow-up studies, 30-50% of children with ADHD continue to be impaired by their symptoms in adolescence or to meet the current diagnostic criteria for ADHD (Lambert et al. 1987, Gittelman et al. 1985). Various factors, including a family history of ADHD, the childhood severity of ADHD, psychiatric comorbidity and psychosocial adversity, have been suggested as predictors of persistence in clinic-referred samples (Biederman & Faraone 2002). So far, only a few studies have used a longitudinal design to study factors related to the continuity of ADHD behaviours in the general population (Taylor et al. 1996, McGee et al. 1991, Kashani et al. 1989), and to the author’s knowledge, there are no studies providing information of changes in ADHD symptoms and DSM-IV ADHD subtypes with advancing age or the associations between these changes and behavioural and family characteristics. It has been suggested, however, that the hyperactive symptoms of some children may remit upon advancing age (El-Sayed et al. 2003, Pearson et al. 1991), while their inattentive symptoms may even increase (Applegate et al. 1997).

### 2.1.7 Psychosocial well-being of the adolescents with ADHD symptoms

ADHD symptoms in adolescence may cause severe psychosocial impairment and distress. The manners of children and adolescents with ADHD are often socially inappropriate and they may be interruptive, aggressive and oppositional. They may also have many kinds of learning problems and cognitive disabilities. (Martinussen et al. 2005, Seidman et al. 2005, Barkley et al. 1990) Children with ADHD have a considerably greater risk than normal children for family conflicts, retention in grade, low academic achievement and eventual educational attainment and impaired social competence as they progress into adolescence and young adulthood. Those with highly
aggressive behaviour in childhood have a much greater risk for many of these outcomes than do the children who are less aggressive. (Fischer et al. 1993, Barkley et al. 1991, Barkley et al. 1990, Gittelman et al. 1985) Children and adolescents with ADHD and especially those with ADHD and psychiatric comorbidity often have poorer psychosocial health than children without ADHD (Klassen et al. 2004). They may have a distorted sense of self (Krueger & Kendall 2001) and suffer from loneliness and the lack of close friends (Meltzer et al. 2003). ADHD is also associated with increased use of health care services and costs (Ray et al. 2006, Seennik et al. 2005, Rowland et al. 2002, Leibson et al. 2001).

Even though genetic factors are so evident in the onset of ADHD (Thapar et al. 1999), elucidation of the personal and social factors present in childhood that predict later negative or positive developmental paths and outcomes are very important (Hechtman et al. 1984). Hechtman et al. (1981) indicated that hyperactive children can develop into young adults 1) whose functioning in many spheres is fairly normal, 2) who continue to have significantly more social, emotional and impulsive problems than matched controls, but whose difficulties are not sufficiently severe to reflect marked psychiatric or antisocial pathology and 3) who clearly constitute a significantly disturbed group requiring psychiatric hospitalization and/or adult jails (Hechtman et al. 1981).

In their 10- to 12-year prospective follow-up of hyperactive children as young adults (aged 17-24 years), Hechtman et al. (1984) aimed to define initial social and environmental factors or clusters of factors that predict the adult outcome. They used initial predictor measures in three main domains; 1) personal characteristics, 2) social-academic measures of school performance, peer relations, adult relations and antisocial behaviour and 3) family parameters of socioeconomic status, mental health of family members and emotional climate at home. They suggested that any particular adult outcome was not associated with a particular initial variable but with the additive interaction of personality characteristics and social as well as family parameters. The findings pointed to the importance of these factors acting synergistically and cumulatively in predicting outcomes, even though some initial measures were more important in predicting particular outcome variables, e.g. IQ in predicting education completed and socio-economic background in predicting work, education and criminal behaviour.

2.2 Risk factors, resilience and protective factors in mental health of children and adolescents

One approach to understand the interaction between a child or adolescent and his or her environment is the ecological-transactional model proposed by Bronfenbrenner (1979). The environment of an individual is seen as layers, each having a minor or major impact on the individual’s life. The beliefs and values of one’s culture and the nature of society compose the macrosystem level, which has an indirect and often unconscious influence on the individual’s life. The exosystem level consists of environments that have daily impacts on the individual’s life such as school, peer group, neighbourhood and the services of society. The most important level is the microsystem which consists of one’s
family and closest friends. The microsystem seems to be the more important, the younger the individual is. For children, another important and proximal level is the level of ontogenic development with its developmental tasks that need to be accomplished. (Bronfenbrenner 1979) The microsystem level and especially the family environment, which is the focus in this thesis, may provide either support or adversity into the life of a child or an adolescent. There is a body of literature in child psychiatry about resilience and protective factors (support) or risk factors (adversity) that may reside in the family environment.

Risk factor is a characteristic, experience or event that is associated with an increase in the probability of a particular outcome (Kraemer et al. 1997). Consequently, a risk factor is related to the outcome. It can be 1) a correlate, which implies merely an association between two factors, 2) a risk factor, which precedes the outcome and is associated with an increase in the likelihood of the outcome, 3) a marker, which is a risk factor that is not causally involved in the outcome or 4) a causal risk factor, which implies a causal relation between the risk factor and the outcome (Kazdin et al. 1997). For example, a correlate could consist of stressors and family dysfunction co-occurring at the same point in time. A risk factor may be a high-fat diet associated with a disease in later life. Age, genotype or levels of neurotransmitters are examples of markers, which are known to be risk factors for certain diseases, but are not causal risk factors. An example of a causal risk factor would be harsh child rearing practices, which have been shown to increase aggressive child behaviour. (Kazdin et al. 1997)

The term “resilience” expresses the capacity of an individual to resist stress or adversity in life and to remain mentally healthy. Resilience can be strengthened by facing and coping successfully with stressful situations. One’s personal and temperamental attributes, stable affectional relationships and positive experiences can also strengthen one’s capacity of resilience (Rutter 1993, 1987). Resilience often stems from the mental concepts of oneself, while protective factors come from the environment. Protective factors and mechanisms modify the impacts of risk factors by lowering the risk of a maladaptive outcome. Protective mechanisms may not have any effect in the absence of adversity, and they may even be stressful events with a positive effect on later risk situations (Rutter 1987, 1985). Thus, protective mechanisms may increase one’s capacity for resilience.

Environmental influence is a wide concept, of which family environment is only one dimension. Consequently, family environment and other psychosocial and physical factors, such as pre- and postnatal vulnerabilities, compose an environment that is unique for an individual and has thus a unique impact on the individual’s life. Unique strategies to cope with environmental vulnerabilities have raised a question about genetic variation, and there has been an increase of gene-environment interaction studies on psychopathology. According to Moffitt and colleagues “gene-environment interaction occurs when the effect of exposure to an environmental pathogen on health is conditional on a person’s genotype or when environmental experience moderates genes’ effects on health” (Moffitt et al. 2005). In other words, gene-environment interaction studies aim to investigate the pathways from the pathogen to a disorder (Moffitt et al. 2005) and to continue the research tradition of protective mechanisms and resilience.
2.3 Theoretical concepts on family research

From the systems theory point of view, family is an organized and independent system. According to Massey (1986), a family system is “an integral unity that both embodies, in its interconnected multiplicity, varying perspectives in the viewpoints of the members and can be observed from different vantage points”. Persons in a family system both make up the system and are shaped by it. Though persons construct systems, systems regulate personal behaviour and persons are influenced by their involvement in previous and ongoing systems (Massey 1986). In other words, family is an endless system where one person is involved in several family systems at the same time, being someone’s child in one system, a parent in another system and a grandparent in a third system.

Families, however, change over time. Some researchers have studied family life as a cycle with its phases, stages and crises. For example, Carter and McGoldrick (1980, 1988) divided the family life cycle into six distinct stages: 1) the launching of the single young adult, 2) the joining of families through marriage, 3) families with young children, 4) families with adolescents, 5) launching children and moving on and 6) families in later life. Each life cycle stage has its emotional and organizational challenges. Carter’s and McGoldrick’s stage four families, i.e. families with adolescents face practical, emotional and relational challenges. At this stage the family is characterized by increasing flexibility of the family boundaries. The practical challenge is to maintain a flexible day-to-day routine, which allows the adolescent to be more independent and to move easily between family, friends and school. The emotional challenge for the parents is to tolerate their feelings of irrelevance and losing control of their adolescent. Maintaining meaningful contact between the parents and adolescents despite the changes and emotional conflicts is the relational challenge for the family. (Gerson 1995)

As for adolescents, they have developmental tasks to accomplish at this age, i.e. they have to develop a sense of identity and autonomy (Erikson 1980). Adolescent rebellion at this stage may result in a crisis in the family system and the family needs to find a balance between parental tolerance and guidance. At this phase it is very difficult for the parents to control the bad behaviour of their adolescent if they did not do it earlier in childhood. (Gerson 1995)

Family environment also includes parenting. Parenting can be good and sensitive to the child’s needs or negative and even hostile. According to Belsky (1984) parenting is directly influenced by three factors: the parents’ personality, the characteristics and personality of the child and the social contexts of stress and support to the family. Parenting is thus multiply determined. The parents’ personality in relation to the child development has been studied especially in regard to the parents’ psychological disturbance (e.g. Rutter et al. 1975), or, more precisely, maternal depression (e.g. Orraschel et al. 1980). The psychiatric disorder of the parents, especially that of the mother, may interfere with parenting and the parental interaction with the offspring. The parents’ personalities are naturally also determined by their own developmental history, where supportive developmental experiences help them to provide sensitive parental care to their offspring later in life (Belsky 1984). As for the child’s characteristics, child’s difficult temperament affects parental functioning (Bates 1980). However, the parent-child interaction is always two-sided, and it is the “goodness-of-fit” between the parent
and the child that determines their relations (Lerner & Lerner 1983). The social contexts of the family have both direct and indirect influences on parenting. Several factors, such as the marital relationship, the parents’ social networks and their employment can serve as stress or support factors to parenting, and the degree of stress or support is determined by individual differences in parenting (Belsky 1984).
3 Aims of the study

The epidemiological part of this study (I, II) utilises the Northern Finland 1986 Birth Cohort data and aims to:

1. Survey adolescents’ attention and behavioural problems in different family environments.
2. Study psychosocial well-being among adolescents’ with ADHD symptoms.

The clinical part of this study (III, IV) utilises the data from a sample of adolescents derived from the Northern Finland 1986 Birth Cohort and aims to:

3. Study the characteristics of ADHD subtypes in childhood and adolescence with special reference to the combined type.
4. Study the major comorbid psychiatric disorders related to adolescent ADHD.
5. Study the potential relationship between comorbidity and the family environment or ADHD symptom severity.
6. Study the remission, persistence and change of ADHD symptoms from childhood to adolescence in relation to the family environment.
4 Subjects and methods

4.1 Study population and procedure

The population of this study was composed of a prospective mother-child birth cohort, the Northern Finland 1986 Birth Cohort, collected from the two northernmost provinces in Finland (Oulu and Lapland) and comprising 9432 liveborn infants whose expected date of birth fell between July 1st 1985 and June 30th 1986 (Järvelin et al. 1993). They have been prospectively followed since the prenatal period. When they were 15 years old they and their parents were sent questionnaires in separate envelopes. The adolescents (N=7344, 80%, 3559 boys and 3785 girls) completed the Youth Self-Report (YSR) questionnaire (Achenbach 2001, 1991) measuring, among other things, attention and behavioural problems and including also questions concerning their school, health and psychosocial well-being. The parents completed the Strengths and Weaknesses of ADHD symptoms and Normal Behaviors (SWAN) questionnaire (Swanson et al 2001a,b) measuring attention problems in their offspring (N=6985, 76%, 3495 boys and 3490 girls) and including questions concerning family type, family income and psychological parental distress. 51.8% of the SWAN questionnaires were filled in by both parents together, 39.8% by the mother, 4.7% by the father, 0.3% by another guardian and 0.5% by another informant. In 2.9% of the questionnaires the information was missing.

To study the adolescents’ attention and behavioural problems (I, see table 1 in page 32), the YSR questionnaire was excluded if there was more than one answer missing out of the 7 items on the attention problems scale or out of the 12 items on the rule-breaking behaviour scale or out of the 17 items on the aggressive behaviour scale. The SWAN questionnaire was excluded if more than one answer was missing out of the 18 ADHD items. In both questionnaires, the missing values were replaced by the mean value of the items on that particular scale for that person. There were 6728 valid SWAN questionnaires. After refusals there were 6888 (3299 boys and 3589 girls) YSR questionnaires and 6643 (3318 boys and 3325 girls) SWAN questionnaires available for analysis. There were more boys than girls with missing data and among those who did not return the questionnaires. In the YSR analyses, the data was adequate for 67.8% of boys and 78.6% of girls out of the total of 9215 15-year-old adolescents. In the SWAN
analyses, the corresponding percentages were 68.2% for boys and 72.8% for girls. More information about the non-responders is available on page 36.

To study the psychosocial well-being of adolescents with ADHD symptoms (II), 6477 SWAN questionnaires (3224 boys and 3253 girls) out of the 6728 valid ones could be used because of refusals (n = 146) and the exclusion of subjects with mental retardation (n = 105). The screening of 6477 subjects yielded 489 (318 boys and 171 girls) adolescents with ADHD symptoms (who scored above the 95th percentile of the SWAN distribution) and 5988 (2906 boys and 3082 girls) without ADHD symptoms who had given the permission to use their data.

The clinical study (III, IV) started about one year later than the epidemiological survey. The data of 6622 subjects out of the 6728 valid SWAN questionnaires could be used, because 106 parents refused to allow the use of their children’s data at this phase. All adolescents scoring above the 95th percentile in the distribution of the SWAN questionnaire and currently living in Northern Finland (N=487) and a random sample of adolescents scoring below the 90th percentile, group matched for gender, place of birth and year of birth (N=315) were invited to take part in a clinical examination in Oulu University Hospital or in the Municipal Medical Centres of Kajaani and Rovaniemi. Altogether 471 (59%) 16- to 18-year-old adolescents, including 272 (55%) from the symptomatic group and 199 (63%) from the control group and their parent(s) participated in this phase. The cases and controls who participated and those who did not participate did not differ significantly with regard to their SWAN scores for ADHD symptoms. The adolescents attended with their mother (70%), father (18%) or both parents (12%). Seven adolescents (or parents) refused the use of the data. Before the final analyses, we excluded those with an estimated IQ below 70 based on parts of the Wechsler Adult Intelligence Scale III (WAIS-III, Wechsler 1981) administered on the day of examination and those with genetic abnormality (n = 7, of those 5 with mild mental retardation, 1 with XXX chromosome, 1 with genetic metabolic syndrome). Consequently, the final analyses included the data of 457 adolescents (see Smalley et al. 2007 for further details of the NFBC 1986 ADHD study data collection procedure).

On the day of the clinical examination the parent(s) were interviewed by using the Finnish translation of the semi-structured Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version (Kiddie-SADS-PL, Kaufman et al. 1997). Whenever both parents were available, they were interviewed together. The adolescents first completed some neuropsychological tests after which they were interviewed by using the Kiddie-SADS-PL. The interviews were videotaped or audiotaped. Both informants signed an informed consent form. The master-level interviewers, who were blind to the adolescents’ SWAN screening status, followed a standardized procedure and combined the information available to make clinical psychiatric diagnoses. An estimate of the adolescent’s overall functioning was made using the Children’s Global Assessment Scale (CGAS, Shaffer et al. 1983). Child and adolescent psychiatrists working in Oulu University Hospital and in the University of California, Los Angeles (UCLA), confirmed all diagnostic assessments. Disagreements were discussed until consensus was reached. In addition to this process, the child and adolescent psychiatrists from Oulu reviewed approximately every tenth interview, while the researcher from UCLA reviewed five interviews to ensure the consistency between the raters. Inter-rater reliability in Finland was established for ADHD (kappa 0.70) and
other diagnoses (kappa 0.77). This screening and the study procedure as well as the
previous data collection on NFBC 1986 are illustrated in figure 1, and the study
populations and study designs of this thesis are shown in table 1.

Fig. 1. The Northern Finland 1986 Birth Cohort data collection and ADHD project. The
boxes in grey represent the databases used in this thesis.
Table 1. Study populations and study designs of this thesis.

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of participants</th>
<th>Study type</th>
<th>Measures</th>
<th>Informant</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>6888 adolescents</td>
<td>questionnaire-based survey</td>
<td>attention problems (SWAN) attention problems (YSR) behavioural problems (YSR) sociodemographic variables</td>
<td>parents adolescents adolescents parents</td>
</tr>
<tr>
<td></td>
<td>6643 parents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>6477 adolescents</td>
<td>questionnaire-based survey</td>
<td>school, health, psychosocial well-being sociodemographic variables</td>
<td>adolescents parents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>457 adolescents + questionnaires</td>
<td>clinical interview</td>
<td>psychiatric diagnoses (Kiddie-SADS-PL) parents’ life satisfaction parents’ interest in adolescent’s activities sociodemographic variables</td>
<td>adolescents + parents parents adolescents parents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>457 adolescents + questionnaires</td>
<td>clinical interview</td>
<td>psychiatric diagnoses (Kiddie-SADS-PL), ADHD type childhood hyperactivity (Rutter B2) parents’ attention problems (ADHD-IV-scale) sociodemographic variables</td>
<td>adolescents + parents teachers parents</td>
</tr>
</tbody>
</table>

4.2 Assessments

The main assessments included the Youth Self-Report (YSR, Achenbach 2001, 1991) and The Strengths and Weaknesses of ADHD symptoms and Normal Behaviors (SWAN, Swanson et al. 2001a,b) in the epidemiological part and the Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version (Kiddie-SADS-PL, Kaufman et al. 1997) and the Children’s Global Assessment Scale (CGAS, Shaffer et al. 1983) in the clinical part of this study. Other assessments included socio-economic and psychosocial measures on family environment, current life situation of the adolescents in this population and the Rutter B2 questionnaire (Rutter 1967).

4.2.1 Youth Self-Report (YSR)

The YSR questionnaire developed by Achenbach and his colleagues (Achenbach 2001, 1991) is a widely used and validated method of psychiatric assessment to evaluate the competencies and problems of 11- to 18-year-old adolescents. The YSR questionnaire has been established as a reliable data collection method in epidemiological research also in Scandinavia (e.g. Heyerdahl et al. 2004, Berg-Nielsen 2003, Broberg et al. 2001) and in Finland (Helstelä & Sourander 2001). The YSR questionnaire includes 40 items which are divided into eight subscales with different numbers of items. The scores for each item range from 0 (not true) through 1 (somewhat or sometimes true) to 2 (very or often true). The scores for the items are summed up to obtain a summary score for each subscale. The
distribution of borderline (above 82\textsuperscript{nd} percentile) cases, i.e. adolescents with problems, is obtained from the summary scores. Due to the discrete distribution of the variables the exact cut-offs for borderline cases were somewhat different in this study (between the 79\textsuperscript{th} and 84\textsuperscript{th} percentiles). Achenbach’s cut-offs were used because the YSR has no validation data available in Finland yet. Three subscales in the YSR were examined: 1) the attention problems scale (the items: acts young, cannot concentrate, cannot sit still, is confused, daydreams, is impulsive, poor school), 2) the rule-breaking behaviour scale (the items: feels no guilt, has bad friends, lies or cheats, prefers older kids, runs away, sets fires, steals at home, steals from other places, swears, thinks too much sex, is truant, uses alcohol or drugs) and 3) the aggressive behaviour scale (the items: argues, is mean, demands attention, destroys own things, destroys other things, disobeys at home, disobeys in school, fights, attacks, screams, is stubborn, mood changes, is suspicious, teases, has temper, threatens, is too loud). The adolescents completed the 1991 version of the YSR, but the data analyses were conducted according to the 2001 version and therefore some items in the 2001 version were missed (on the attention problems scale: items fails to finish, inattentive, on the rule-breaking behaviour scale: breaks rules, uses tobacco).

4.2.2 Strengths and Weaknesses of ADHD symptoms and Normal Behaviors (SWAN)

The SWAN questionnaire developed by Swanson and his colleagues measures problems in attention and hyperactivity (Swanson et al 2001a,b). The SWAN questionnaire, which includes several subscales, is a modification of the Swanson, Nolan and Pelham (SNAP) rating scale for ADHD. The items are based on the ADHD symptoms described in the DSM-IV including 18 symptoms of ADHD (table 2, American Psychiatric Association 1994). These symptoms are translated into statements which are rated on a 7-point rating scale anchored in the middle to average behaviour scored and rated as 0. Problem behaviours are rated as 1 (slightly below average), 2 (below average) and 3 (far below average). Strengths are rated as –1 (slightly above average), -2 (above average) and –3 (far above average). The ratings can be summed up into summary scores. Swanson recommends using the 95\textsuperscript{th} percentile of the distribution as a cut-off point for problems and this was done in this study. The SWAN ADHD subscale (statements 1-18) was chosen to be used in this study, because this subscale best illustrated the symptoms of ADHD in DSM-IV. At the moment there are no normative data available about the SWAN questionnaire (Collett et al. 2003), but Swanson and his colleagues validated the SWAN questionnaire among 582 school-aged children in the United States and found the distribution of the summary scores for the ADHD scale to approximate the normal distribution by a mean of -.45 and a standard deviation of 1.46 (Swanson et al 2001a,b).
Table 2. Diagnostic criteria of ADHD according to the DSM-IV.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Six or more of the following symptoms of inattention or six or more of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:</td>
</tr>
<tr>
<td></td>
<td>Inattentive symptoms</td>
</tr>
<tr>
<td></td>
<td>a) makes a lot of careless mistakes</td>
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<tr>
<td></td>
<td>b) difficulty sustaining attention on tasks</td>
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<tr>
<td></td>
<td>c) does not listen</td>
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<tr>
<td></td>
<td>d) difficulty following instructions</td>
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<tr>
<td></td>
<td>e) difficulty organizing tasks</td>
</tr>
<tr>
<td></td>
<td>f) dislikes/avoids tasks</td>
</tr>
<tr>
<td></td>
<td>g) loses things</td>
</tr>
<tr>
<td></td>
<td>h) easily distracted</td>
</tr>
<tr>
<td></td>
<td>i) forgetful in daily activities</td>
</tr>
<tr>
<td></td>
<td>Hyperactive-impulsive symptoms</td>
</tr>
<tr>
<td></td>
<td>a) fidgets</td>
</tr>
<tr>
<td></td>
<td>b) difficulty remaining seated</td>
</tr>
<tr>
<td></td>
<td>c) runs or climbs excessively</td>
</tr>
<tr>
<td></td>
<td>d) difficulty playing quietly</td>
</tr>
<tr>
<td></td>
<td>e) driven by motor</td>
</tr>
<tr>
<td></td>
<td>f) talks excessively</td>
</tr>
<tr>
<td></td>
<td>g) blurts out answers</td>
</tr>
<tr>
<td></td>
<td>h) difficulty waiting turn</td>
</tr>
<tr>
<td></td>
<td>i) interrupts or intrudes</td>
</tr>
<tr>
<td>B</td>
<td>Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years.</td>
</tr>
<tr>
<td>C</td>
<td>Some impairment of the symptoms is present in two or more settings.</td>
</tr>
<tr>
<td>D</td>
<td>There must be clear evidence of clinically significant impairment in social, academic or occupational functioning.</td>
</tr>
<tr>
<td>E</td>
<td>The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia or other Psychotic Disorder and are not better accounted for by another mental disorder.</td>
</tr>
</tbody>
</table>

4.2.3 Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version (Kiddie-SADS-PL)

The Kiddie-SADS-PL is a semi-structured interview designed to assess current and past episodes of psychopathology in children and adolescents between the ages 6 and 18 using the DSM-IV criteria. The interview is administered to both the parent and the child or adolescent. The primary diagnoses assessed with the Kiddie-SADS-PL include: major depression, dysthymia, mania, hypomania, cyclothymia, bipolar disorders, schizoaffective disorders, schizophrenia, schizophreniform disorder, panic disorders,

The DSM-IV-based diagnosis of ADHD also appears to be valid among adolescents (Faraone et al 2002, Biederman et al 1998). The adolescent diagnosis of ADHD was set according to the current ADHD symptoms of the adolescent and also according to other criteria (table 2). The childhood diagnosis of ADHD was set according to the informants’ retrospective recall of their childhood symptoms (from early childhood to the age of 12) and other criteria based on the interview. Hospital records were also used if available. To receive a diagnosis of CD or ODD the proband had to meet all criteria, with the exception of the DSM-IV rule that ODD was not excluded even when CD was diagnosed. Consequently, the proband could receive both diagnoses, which were considered separate conditions. The associations between the two behavioural disorders and ADHD were studied separately and together.

4.2.4 Children’s Global Assessment Scale (CGAS)

The Children’s Global Assessment Scale (CGAS), an adaptation of the Global Assessment Scale for adults, is used to estimate children’s level of overall functioning in several domains of life, including school, family and social interactions with friends and peers (Shaffer et al. 1983). Given its good psychometric properties and its simplicity it is recommended as a reliable tool in both clinical and research work. The range for CGAS scores is 0 – 100 with higher scores indicating better levels of functioning. CGAS scores below 70 are considered as indicating psychiatric disturbance and limited functioning (Shaffer et al. 1983). For children without any lifetime history of psychiatric disturbance only a current CGAS score is assigned. For children with current or past psychiatric disorder two CGAS scores can be assigned, one for current functioning and one for the worst functioning in the past. In this study the CGAS score was used to estimate only the adolescent’s current functioning.

4.2.5 Other assessments and study variables

In the epidemiological part of this study (I, II), the author examined the associations between some of the adversity factors found by Rutter (Rutter et al. 1975) and attention and behavioural problems. For that purpose data about the family environment was obtained from the parents’ questionnaire. The variables chosen were family type, number of children in the family, birth order of the child and social status of the family. The social status of the family was measured with the mother’s education, because mothers were slightly better educated than fathers (see Taanila et al. 2004). Parents’ questionnaire also included questions on the parents’ work, health and living habits. To survey the
adolescents’ psychosocial well-being (II), the adolescents’ questionnaire also included questions about their family, friends, school, health, living habits and hobbies. The variables chosen were the current school type, repeated grade, liking school, educational plans, physical health, physician and school nurse visits, life satisfaction, being pleased with one’s appearance, close friends, parents’ interest in adolescent’s activities and having joint activities with the family.

For the basic family characteristic variables in the clinical part of this study (III, IV), the parents provided questionnaire-based information about their family type and gross family income per year. Family type was here dichotomized as intact family (both biological parents living together with the adolescent) and non-intact family (single-parent families, divorced or remarried parents). Average income per household in the year 2003 was drawn from the statistics provided by Statistics Finland (2005). To measure the psychosocial family environment, the parents also provided questionnaire-based information about their subjective feelings of stress (Do you feel stressed nowadays?), their current life satisfaction (How satisfied are you to your life at the moment?) and their attention problems (ADHD-IV scale, DuPaul et al. 1998). The adolescents provided questionnaire-based information about their parents’ interest in their activities (Are your parents interested in your school, hobbies or your other important matters?).

In addition, teachers’ evaluation of childhood hyperactivity was used in the clinical part of this study. Childhood hyperactivity was measured with the sum scores of three hyperactivity items (item 1, the child is restless, does not have the patience to sit down for a longish period of time, item 3, wriggles and is restless and item 16, is not able to concentrate on anything for a longish period of time) on the Rutter B2 questionnaire for teachers (Rutter 1967), which was completed when the children in the cohort were 8 years old (Figure 1 in page 31). The Rutter B2 questionnaire for teachers assesses the emotional and behavioural problems of children. Of the 26 items scored 0 (does not apply), 1 (applies somewhat) or 2 (certainly applies), subscales of neurotic, anti-social and hyperactive behaviour can be obtained. A total score of 9 or above is considered as indicative of problems (Rutter 1967).

4.3 Statistical methods

The data was analysed by using the SPSS 14.0 and Mplus 3.1 statistical analysis software. The basic analyses in the epidemiological part (I, II) included frequency counts, appropriate tests of significance (e.g. Student’s t-test, analysis of variance) and computations of Pearson’s correlation coefficients to measure the correlations between attention and behavioural problems. Logistic regression was used to study the associations between attention and behavioural problems and family characteristics, and the results are presented with odds ratios with 95% confidence intervals (OR, 95%CI). All variables (family type, social status of the family, birth order of the adolescent, number of children in the family) entered into the multivariate model were adjusted for the other variables in the study. An adjusted logistic regression model was also created to study the psychosocial well-being of adolescents with and without ADHD symptoms. In the logistic regression model the variables were adjusted for family type, social status of
the family, birth order of the adolescent and behavioural problems of the adolescent (measured with the YSR rule-breaking behaviour scale and the YSR aggressive behaviour scale), as these variables were considered to interfere with the associations under study. The models were made separately for boys and girls. A latent class analysis based on psychosocial variables (life satisfaction, being pleased with one’s appearance, close friends) was also performed. Best fit was achieved for a model with four classes. The latent class analysis is a specific statistical method developed to classify subjects according to selected characteristics (Hagenaars et al. 2002). The sample sizes in the multivariate models and latent class analysis were lower due to missing data in the confounding variables.

In the clinical part (III, IV), the Pearson’s chi-square test or Fisher’s Exact Test was used for nominal variables and suitable parametric tests (e.g. Student’s t-test, analyses of variance) for normally distributed continuous variables. Two logistic regression models were created to study the associations between comorbidity and family characteristics. Bonferroni corrections for multiple comparisons were not used as all the tests were based on the author’s hypothesis of interaction between the variables. A principal axis factor analysis with varimax rotation (eigenvalue 1 as a criterion for a number of factors), was used to explore the symptoms of the combined type and a logistic regression model was constructed to study the predictors of the persistence of ADHD symptoms. In this phase, analyses were also done separately for boys and girls, but as the results were similar for both genders, gender was treated as a covariate in the logistic regression. The variables were not adjusted due to the small number of cases in the analyses. All the analyses were made two-tailed. P-values of less than 0.05 were considered statistically significant.

4.4 Ethical considerations and personal involvement

The NFBC 1986 ADHD study was approved by the Ethical Committee of The Ostrobothnia District Hospital in Oulu. After complete description of the study to the adolescents and their parents, written informed consent was obtained from all informants during the epidemiological and clinical studies.

The author of this thesis has participated in the NFBC 1986 ADHD study as a researcher since the spring 2002. She has conducted 141 Kiddie-SADS-PL interviews and participated in all diagnostic consensus discussions. She has also participated in designing the use of statistical methods in the four original articles. All presentations of methods, presentations of results and report writing for the three original articles (I, III and IV) and this thesis have been done by the author. In one original article (II) the author actively participated in presenting the methods, results and conclusions and in report writing.
5 Results

5.1 Attention and behavioural problems of Finnish adolescents (I)

Among the adolescents in the NFBC 1986, girls reported more often than boys problems in attention and behaviour (27% vs. 14% for the attention problems scale, 22% vs. 19% for the rule-breaking scale and 20% vs. 12% for the aggressive scale). Girls reported a more than twofold number of attention problems than boys (odds ratio for girls 2.36, 95% CI 2.08-2.67). The corresponding odds ratios for rule-breaking and aggressive behaviour were 1.15 (95% CI 1.02-1.29) and 1.79 (95% CI 1.57-2.04), respectively. The mean summary scores for girls on the YSR scales were all significantly higher than those for boys (4.61 vs. 3.41, p<0.001 for attention problems, 4.25 vs. 3.69, p<0.001 for rule-breaking behaviour, 7.18 vs. 5.63, p<0.001 for aggressive behaviour) To obtain more information about the differences between the genders the means for individual items on the YSR scales were analysed. On the attention problems scale, the means were higher for girls than for boys in all items. On the rule-breaking behaviour scale, the means were higher for girls than for boys in the items prefers older kids, runs away, steals from home, is truant and uses alcohol or drugs. On the aggressive behaviour scale, the means were higher for girls than for boys in the items argues, demands attention, disobeys at home, screams, is stubborn, shows mood changes, is suspicious, has temper tantrums and is too loud.

According to the parents, however, altogether 6.5% of boys and 3.1% of girls scored at approximately the 95th percentile on the ADHD scale in this population (odds ratio for boys 2.18, 95% CI 1.71-2.77). The mean summary score on the SWAN ADHD scale was significantly higher for boys than for girls (-0.97 vs. -1.24, p<0.001).

Among boys, Pearson’s correlation between attention problems and rule-breaking behaviour was .47, that between attention problems and aggressive behaviour .59 and that between rule-breaking and aggressive behaviour .62. Among girls, the corresponding correlations were .48, .61 and .64.
5.1.1 Attention and behavioural problems and family characteristics

The associations between family characteristics and attention and behavioural problems were assessed with an adjusted model of logistic regression with odds ratios and 95% confidence intervals. Data derived from the YSR questionnaire showed that boys living in reconstructed families or with a divorced parent had higher risks for rule-breaking behaviour than boys living in intact families (table 3). Boys living in other than intact families also had higher risks for ADHD symptoms in the SWAN questionnaire. Boys who were the oldest children reported less attention problems compared to the middle ones. Boys from very large families (11 to 19 children) reported least problems. The social status of the family had little association with these problems. However, the sons of skilled workers had a higher risk for attention and behavioural problems than the boys in the other groups.

As for girls, those living in reconstructed families had higher risks for YSR attention problems (table 4). The risks for rule-breaking and aggressive behaviour were also higher among the girls living in other than intact families, especially girls living in always single-parent families were at risk for aggressive behaviour. As for girls, only children and youngest children had less behaviour problems compared to middle ones. Girls living in large and very large families had less rule-breaking behaviour compared to girls living in families with 2 to 4 children. Among girls, social status was not associated with these problems.

Because more questionnaires were received from girls and their parents than from boys and their parents, the missing data in this phase was analysed. The information from previous studies in this population (see figure 1 in page 31) was used as was the information from the YSR or SWAN questionnaires in this study if only one of these questionnaires was received back. There were indeed more boys than girls with missing data (32% vs. 21% in the YSR and 32% vs. 27% in the SWAN). Additionally, the adolescents with missing data lived more commonly in other than intact families (32% vs. 18% in the YSR and 25% vs. 17% in the SWAN) or in a large city (71% vs. 67% in the YSR and 70% vs. 67% in the SWAN) or were children of unskilled workers (71% vs. 64% in the YSR and 72% vs. 63% in the SWAN). Also, those who filled in both SWAN and YSR scored statistically significantly lower on SWAN, i.e. had less attention problems, compared to those who filled in only SWAN but not YSR (mean score for boys -1.00 vs. -0.73 and for girls -1.25 vs. -0.96, t-tests, p<0.001).
<table>
<thead>
<tr>
<th>Variable</th>
<th>YSR Attention problems</th>
<th>YSR Rule-breaking behaviour</th>
<th>YSR Aggressive behaviour</th>
<th>SWAN ADHD scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% with problems</td>
<td>OR (95% CI)*</td>
<td>% with problems</td>
</tr>
<tr>
<td>Family type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intact</td>
<td>2101</td>
<td>12.5</td>
<td>1</td>
<td>16.1</td>
</tr>
<tr>
<td>Divorced</td>
<td>372</td>
<td>15.3</td>
<td>1.16 (0.82-1.66)</td>
<td>26.9</td>
</tr>
<tr>
<td>Reconstructed</td>
<td>223</td>
<td>18.8</td>
<td>1.64 (1.12-2.40)</td>
<td>26.5</td>
</tr>
<tr>
<td>Single</td>
<td>18</td>
<td>5.6</td>
<td>0.45 (0.06-3.58)</td>
<td>27.8</td>
</tr>
<tr>
<td>Birth order</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oldest child</td>
<td>664</td>
<td>10.7</td>
<td>0.68 (0.48-0.96)</td>
<td>16.1</td>
</tr>
<tr>
<td>Youngest child</td>
<td>957</td>
<td>14.8</td>
<td>1.01 (0.75-1.36)</td>
<td>20.9</td>
</tr>
<tr>
<td>Middle child</td>
<td>903</td>
<td>13.7</td>
<td>1</td>
<td>17.6</td>
</tr>
<tr>
<td>Only child</td>
<td>235</td>
<td>18.7</td>
<td>1.30 (0.85-2.01)</td>
<td>23.4</td>
</tr>
<tr>
<td>Number of children in the family</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>235</td>
<td>18.7</td>
<td>1.30 (0.85-2.01)</td>
<td>23.4</td>
</tr>
<tr>
<td>2-4</td>
<td>2191</td>
<td>13.8</td>
<td>1</td>
<td>19.6</td>
</tr>
<tr>
<td>5-10</td>
<td>353</td>
<td>12.7</td>
<td>0.96 (0.65-1.42)</td>
<td>15.3</td>
</tr>
<tr>
<td>11-19</td>
<td>140</td>
<td>7.1</td>
<td>0.45 (0.21-0.97)</td>
<td>7.1</td>
</tr>
<tr>
<td>Social status of the family</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>2113</td>
<td>13.2</td>
<td>1</td>
<td>18.6</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>551</td>
<td>17.2</td>
<td>1.31 (0.99-1.74)</td>
<td>23.4</td>
</tr>
<tr>
<td>Unskilled workers</td>
<td>165</td>
<td>9.7</td>
<td>0.65 (0.33-1.28)</td>
<td>10.3</td>
</tr>
<tr>
<td>Farmers</td>
<td>114</td>
<td>11.4</td>
<td>1.13 (0.62-2.07)</td>
<td>13.2</td>
</tr>
</tbody>
</table>

*OR = odds ratio, CI = confidence interval. All odds ratios are adjusted with other variables in the table. Statistically significant associations are given in italics.
Table 4. Associations between attention and behavioural problems on the YSR scales (N = 2682) and the SWAN scale (N = 2793) and family characteristics of girls at the age of 15 years. The percentage indicates the adolescents with problems.

<table>
<thead>
<tr>
<th>Variable</th>
<th>YSR Attention problems</th>
<th>YSR Rule-breaking behaviour</th>
<th>YSR Aggressive behaviour</th>
<th>SWAN ADHD scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% with problems</td>
<td>OR (95% CI)*</td>
<td>N</td>
</tr>
<tr>
<td>Family type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intact</td>
<td>2187</td>
<td>24.7</td>
<td>1</td>
<td>2273</td>
</tr>
<tr>
<td>Divorced</td>
<td>373</td>
<td>29.2</td>
<td>1.28 (0.98-1.66)</td>
<td>393</td>
</tr>
<tr>
<td>Reconstructed</td>
<td>315</td>
<td>34.6</td>
<td>1.71 (1.30-2.25)</td>
<td>330</td>
</tr>
<tr>
<td>Single</td>
<td>32</td>
<td>31.3</td>
<td>1.05 (0.41-2.70)</td>
<td>35</td>
</tr>
<tr>
<td>Birth order</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oldest child</td>
<td>677</td>
<td>24.2</td>
<td>0.84 (0.66-1.08)</td>
<td>706</td>
</tr>
<tr>
<td>Youngest child</td>
<td>971</td>
<td>28.6</td>
<td>1.11 (0.88-1.38)</td>
<td>1012</td>
</tr>
<tr>
<td>Middle child</td>
<td>1046</td>
<td>25.6</td>
<td>1</td>
<td>1086</td>
</tr>
<tr>
<td>Only child</td>
<td>257</td>
<td>26.1</td>
<td>0.91 (0.64-1.28)</td>
<td>276</td>
</tr>
<tr>
<td>Number of children in the family</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>257</td>
<td>26.1</td>
<td>0.91 (0.64-1.28)</td>
<td>276</td>
</tr>
<tr>
<td>2-4</td>
<td>2331</td>
<td>23.4</td>
<td>1</td>
<td>2438</td>
</tr>
<tr>
<td>5-10</td>
<td>404</td>
<td>24.5</td>
<td>0.98 (0.74-1.20)</td>
<td>423</td>
</tr>
<tr>
<td>11-19</td>
<td>128</td>
<td>19.5</td>
<td>0.72 (0.44-1.18)</td>
<td>126</td>
</tr>
<tr>
<td>Social status of the family</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>2210</td>
<td>26.2</td>
<td>1</td>
<td>2302</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>641</td>
<td>29.6</td>
<td>1.18 (0.95-1.46)</td>
<td>679</td>
</tr>
<tr>
<td>Unskilled workers</td>
<td>151</td>
<td>25.2</td>
<td>0.89 (0.58-1.39)</td>
<td>159</td>
</tr>
<tr>
<td>Farmers</td>
<td>140</td>
<td>27.9</td>
<td>1.33 (0.88-2.00)</td>
<td>147</td>
</tr>
</tbody>
</table>

*OR = odds ratio, CI = confidence interval. All odds ratios are adjusted with other variables in the table. Statistically significant associations are given in italics.
A majority of the adolescents (69.1%) lived in intact families, even though the adolescents with ADHD symptoms lived more often than those without such symptoms in other than intact families (34.5% vs. 23.4%, OR 1.7, 95% CI 1.4-2.1). Based on their mother’s educational level, most of the adolescents (69.7%) belonged to the first social class. However, the adolescents with ADHD symptoms belonged more commonly than those without to other than the first social class (34.6% vs. 29.0%, OR 1.3, 95% CI 1.1-1.6). When the genders were assessed separately, the differences remained significant only for boys. There was no significant difference in the birth order of the adolescents between the groups. The adolescents with ADHD symptoms reported more behavioural problems, i.e. scored above the 82nd percentile on either the rule-breaking or the aggressive behaviour scales in the YSR, (55.4% vs. 27.1%, OR 3.3, CI 2.7-4.1) than those without.

The adolescents with ADHD symptoms attended more often special school (4.8% vs. 0.8, OR 5.62, CI 2.88-10.98) than those without ADHD symptoms. They also had repeated a grade more often (7.5% vs. 1.5, OR 2.80, CI 1.57-5.00) than their counterparts, and they did not like school very much (51.8% vs. 34.6, OR 2.50, CI 1.57-4.00) or did not like it at all (10.2% vs. 2.8, OR 5.31, CI 2.31-12.18). In the future they reported they preferred vocational education to senior secondary school (44.2% vs. 24.0, OR 5.73, CI 3.90-8.43). Over one third of the adolescents with ADHD symptoms were uncertain about their future study plans (for more detailed information, see table 1 in paper II). These results were similar to boys and girls.

The adolescents with ADHD symptoms reported their health as moderately poor 22.7% vs. 14.0, OR 1.43, CI 1.07-1.89 and used health services more often than those without symptoms (table 5). Especially boys with ADHD symptoms had visited a physician or a school nurse several times during the last six months, while girls had mainly visited the school nurse.

Most of the adolescents with and without ADHD symptoms reported being fairly or very satisfied with their life situation (81.8% and 91.1%), even though the fairly dissatisfied adolescents included significantly more adolescents (especially girls) with ADHD symptoms (OR for girls 2.5, CI 1.3-4.5). Boys with ADHD symptoms reported more frequently than the others that they had no close friends (OR for boys 1.7, CI 1.1-2.7). The adolescents with ADHD symptoms reported more often than the others that they were not pleased with their appearance (table 6). As to family life, most of the adolescents reported their parents to be interested in their school attendance, hobbies and other important matters (86.5% of those without ADHD symptoms and 79.05% of those with symptoms, OR 0.5, 95% CI 0.4-0.7). However, the adolescents living in reconstructed families reported least parental interest (never or seldom interested: 18.7% in reconstructed families and 12.9% in intact families, OR 1.6, CI 1.2-2.0). Nearly half (48.0%) of the adolescents with ADHD symptoms reported having joint activities with their family members daily, but the group of adolescents who did not have such activities at all (3.3% vs. 1.2%, OR 2.2, CI 1.1-4.5) or had them only monthly (6.1% vs. 3.3%, OR
2.4, CI 1.5-3.9) included more of those with ADHD symptoms (table 6). However, family structure was not associated with having joint activities with family members.

To find out if poor psychosocial well-being was reported by the same adolescents with ADHD symptoms, a latent class analysis was performed and a four-class model was created based on the distribution of the selected psychosocial variables (life satisfaction, being pleased with one’s appearance, close friends) among the adolescents in this study (see table 4 in paper II). Class 1 included adolescents who were satisfied with life, were pleased with their appearance and had close friends. Class 2 included adolescents who were not satisfied with life, were not pleased with their appearance but had close friends. Class 3 included adolescents who were satisfied with life and were pleased with their appearance but did not have close friends. Class 4 included adolescents who were not satisfied with life, were not pleased with their appearance and had no close friends. There were an almost twofold proportion of adolescents with ADHD symptoms (SWAN cases) in class 4 compared to class 1 (9.7% vs. 5.6%, OR 1.8, CI 1.1-2.8). Adolescents in class 4 also had more ADHD symptoms (SWAN positive scores) than those in class 1 (means 1.44 vs. 1.05, Student’s t test, t 2.630, p = 0.009). These results were quite similar among boys and girls, although there were more boys (64%) than girls in class 3, and their SWAN score was 1.66 compared to 0.83 for girls. Class 2 consisted mostly of girls (83%).
Table 5. Self-reported physical health among adolescents with and without ADHD symptoms.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All subjects (N = 6477)</th>
<th></th>
<th>Boys (N = 3224)</th>
<th></th>
<th>Girls (N = 3253)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADHD</td>
<td>Others</td>
<td>OR (95% CI)*</td>
<td>ADHD</td>
<td>Others</td>
<td>OR (95% CI)*</td>
</tr>
<tr>
<td>Self-reported health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>very poor</td>
<td>2</td>
<td>0.5</td>
<td>7</td>
<td>0.1</td>
<td>4.19 (0.73-24.14)</td>
<td>1</td>
</tr>
<tr>
<td>poor</td>
<td>11</td>
<td>2.6</td>
<td>45</td>
<td>0.8</td>
<td>2.76 (1.16-6.58)</td>
<td>6</td>
</tr>
<tr>
<td>moderately poor</td>
<td>98</td>
<td>22.7</td>
<td>789</td>
<td>14.0</td>
<td>1.43 (1.07-1.89)</td>
<td>54</td>
</tr>
<tr>
<td>good</td>
<td>245</td>
<td>56.8</td>
<td>3371</td>
<td>59.8</td>
<td>1</td>
<td>155</td>
</tr>
<tr>
<td>very good</td>
<td>75</td>
<td>17.4</td>
<td>1429</td>
<td>25.3</td>
<td>0.70 (0.51-0.96)</td>
<td>57</td>
</tr>
<tr>
<td>Use of health services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>physician visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>none</td>
<td>122</td>
<td>29.8</td>
<td>2045</td>
<td>37.1</td>
<td>1</td>
<td>86</td>
</tr>
<tr>
<td>once</td>
<td>127</td>
<td>31.0</td>
<td>1927</td>
<td>34.9</td>
<td>1.05 (0.78-1.41)</td>
<td>85</td>
</tr>
<tr>
<td>twice</td>
<td>92</td>
<td>22.4</td>
<td>925</td>
<td>16.8</td>
<td>1.65 (1.19-2.29)</td>
<td>55</td>
</tr>
<tr>
<td>three times or more</td>
<td>69</td>
<td>16.8</td>
<td>618</td>
<td>11.2</td>
<td>1.72 (1.20-2.47)</td>
<td>35</td>
</tr>
<tr>
<td>school nurse visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>none</td>
<td>81</td>
<td>19.5</td>
<td>1241</td>
<td>22.5</td>
<td>1</td>
<td>63</td>
</tr>
<tr>
<td>once</td>
<td>140</td>
<td>33.7</td>
<td>2343</td>
<td>42.5</td>
<td>0.90 (0.66-1.25)</td>
<td>96</td>
</tr>
<tr>
<td>twice</td>
<td>78</td>
<td>18.8</td>
<td>1113</td>
<td>20.2</td>
<td>1.01 (0.70-1.47)</td>
<td>54</td>
</tr>
<tr>
<td>three times or more</td>
<td>116</td>
<td>28.0</td>
<td>811</td>
<td>14.7</td>
<td>2.11 (1.48-3.01)</td>
<td>48</td>
</tr>
</tbody>
</table>

*OR = odds ratio, CI = confidence interval. Odds ratio was adjusted in the logistic regression analysis for family type, social status of the family, birth order of the adolescent, behavioural problems of the adolescent and also for gender when studying all subjects together. Statistically significant associations are given in italics. N’s may vary due to missing information.

During the last six months
<table>
<thead>
<tr>
<th>Variable</th>
<th>All subjects (N = 6477)</th>
<th>ADHD (n = 3224)</th>
<th>Others (n = 3253)</th>
<th>OR (95% CI)</th>
<th>ADHD (n = 3224)</th>
<th>Others (n = 3253)</th>
<th>OR (95% CI)</th>
<th>ADHD (n = 3224)</th>
<th>Others (n = 3253)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life satisfaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>very dissatisfied</td>
<td>11</td>
<td>2.6</td>
<td>57</td>
<td>1.0</td>
<td>1.63 (0.70-3.78)</td>
<td>8</td>
<td>3.0</td>
<td>30</td>
<td>1.1</td>
<td>1.47 (0.53-4.06)</td>
</tr>
<tr>
<td>fairly dissatisfied</td>
<td>33</td>
<td>7.8</td>
<td>219</td>
<td>3.9</td>
<td>1.80 (1.15-2.81)</td>
<td>17</td>
<td>6.4</td>
<td>95</td>
<td>3.6</td>
<td>1.28 (0.66-2.47)</td>
</tr>
<tr>
<td>fairly satisfied</td>
<td>250</td>
<td>59.1</td>
<td>3348</td>
<td>59.9</td>
<td>1</td>
<td>163</td>
<td>61.0</td>
<td>1504</td>
<td>57.1</td>
<td>1</td>
</tr>
<tr>
<td>very satisfied</td>
<td>96</td>
<td>22.7</td>
<td>171</td>
<td>31.2</td>
<td>0.91 (0.69-1.21)</td>
<td>61</td>
<td>22.8</td>
<td>905</td>
<td>34.3</td>
<td>0.76 (0.53-1.08)</td>
</tr>
<tr>
<td>Pleased with appearance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>quite pleased with appearance</td>
<td>152</td>
<td>41.9</td>
<td>2584</td>
<td>51.0</td>
<td>1</td>
<td>94</td>
<td>41.2</td>
<td>1169</td>
<td>49.8</td>
<td>1</td>
</tr>
<tr>
<td>nothing wrong with appearance</td>
<td>122</td>
<td>33.6</td>
<td>1449</td>
<td>28.6</td>
<td>1.45 (1.09-1.94)</td>
<td>96</td>
<td>42.1</td>
<td>928</td>
<td>39.5</td>
<td>1.43 (1.00-2.05)</td>
</tr>
<tr>
<td>worried about looking unpleasant</td>
<td>47</td>
<td>12.9</td>
<td>671</td>
<td>13.2</td>
<td>1.42 (0.98-2.06)</td>
<td>29</td>
<td>12.7</td>
<td>192</td>
<td>8.2</td>
<td>2.38 (1.46-3.88)</td>
</tr>
<tr>
<td>feeling ugly</td>
<td>39</td>
<td>10.7</td>
<td>294</td>
<td>5.8</td>
<td>2.33 (1.46-3.70)</td>
<td>8</td>
<td>3.5</td>
<td>43</td>
<td>1.8</td>
<td>2.08 (0.77-5.62)</td>
</tr>
<tr>
<td>Close friend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no close friends</td>
<td>45</td>
<td>10.7</td>
<td>373</td>
<td>6.7</td>
<td>1.72 (1.16-2.56)</td>
<td>38</td>
<td>14.5</td>
<td>278</td>
<td>10.6</td>
<td>1.74 (1.12-2.71)</td>
</tr>
<tr>
<td>one close friend</td>
<td>113</td>
<td>27.0</td>
<td>1316</td>
<td>23.5</td>
<td>1.19 (0.89-1.59)</td>
<td>79</td>
<td>30.2</td>
<td>703</td>
<td>26.7</td>
<td>1.12 (0.77-1.62)</td>
</tr>
<tr>
<td>two close friends</td>
<td>87</td>
<td>20.8</td>
<td>1295</td>
<td>23.1</td>
<td>0.99 (0.73-1.35)</td>
<td>43</td>
<td>16.4</td>
<td>484</td>
<td>18.4</td>
<td>0.98 (0.63-1.53)</td>
</tr>
<tr>
<td>several close Friends</td>
<td>174</td>
<td>41.5</td>
<td>2610</td>
<td>46.7</td>
<td>1</td>
<td>102</td>
<td>38.9</td>
<td>1164</td>
<td>44.3</td>
<td>1</td>
</tr>
<tr>
<td>Adolescent’s report on parents’ interest in adolescent’s activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>never or seldom interested</td>
<td>89</td>
<td>21.0</td>
<td>758</td>
<td>13.5</td>
<td>1.18 (0.88-1.59)</td>
<td>51</td>
<td>19.0</td>
<td>362</td>
<td>13.6</td>
<td>1.01 (0.67-1.51)</td>
</tr>
<tr>
<td>almost always interested</td>
<td>354</td>
<td>79.0</td>
<td>4853</td>
<td>86.5</td>
<td>1</td>
<td>217</td>
<td>81.0</td>
<td>2293</td>
<td>86.4</td>
<td>1</td>
</tr>
<tr>
<td>Joint activities with family</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>never</td>
<td>14</td>
<td>3.3</td>
<td>66</td>
<td>1.2</td>
<td>2.20 (1.09-4.46)</td>
<td>7</td>
<td>2.6</td>
<td>45</td>
<td>1.7</td>
<td>1.10 (0.40-3.04)</td>
</tr>
<tr>
<td>occasionally</td>
<td>104</td>
<td>24.5</td>
<td>900</td>
<td>16.1</td>
<td>1.24 (0.92-1.66)</td>
<td>69</td>
<td>25.6</td>
<td>458</td>
<td>17.4</td>
<td>1.11 (0.76-1.64)</td>
</tr>
<tr>
<td>monthly</td>
<td>26</td>
<td>6.1</td>
<td>182</td>
<td>3.3</td>
<td>2.40 (1.49-3.89)</td>
<td>16</td>
<td>5.9</td>
<td>79</td>
<td>3.0</td>
<td>2.76 (1.49-5.13)</td>
</tr>
<tr>
<td>weekly</td>
<td>77</td>
<td>18.1</td>
<td>902</td>
<td>16.2</td>
<td>1.00 (0.72-1.39)</td>
<td>48</td>
<td>17.8</td>
<td>445</td>
<td>16.9</td>
<td>1.03 (0.67-1.56)</td>
</tr>
<tr>
<td>daily</td>
<td>204</td>
<td>48.0</td>
<td>3526</td>
<td>63.2</td>
<td>1</td>
<td>130</td>
<td>48.1</td>
<td>1602</td>
<td>60.9</td>
<td>1</td>
</tr>
</tbody>
</table>

*OR = odds ratio, CI = confidence interval. Odds ratio was adjusted in the logistic regression analysis for family type, social status of the family, birth order of the adolescent, behavioural problems of the adolescent and also for gender when studying all subjects together. Statistically significant associations are given in italics. N’s may vary due to missing information.
5.3 Characteristics of ADHD subtypes (IV)

The clinical semi-structured Kiddie-SADS-PL interview was conducted with 457 adolescents. A definite diagnosis of ADHD either in childhood or in adolescence was established for 163 subjects (140 subjects were originally SWAN cases and 23 SWAN controls). The diagnosis of ADHD was more common in childhood than in adolescence (n = 148 vs. n = 105). The most prevalent subtypes were the combined type in childhood (n = 64, 43%), in which group boys were overrepresented (n = 50 boys vs. n = 14 girls), and the inattentive type in adolescence (n = 67, 64%, n = 48 boys, n = 19 girls, table 7). The hyperactive-impulsive type was the least prevalent subtype in both childhood and adolescence. The adolescents with the combined subtype had lower CGAS scores (F=4.488, p=0.023) compared to the adolescents with the inattentive type. They also had fathers with more attention problems (F=4.405, p=0.016). The inattentive children had a significantly later age of onset for ADHD than those with the other subtypes (F=17.192, p<0.001, table 7). After separate analyses for boys and girls these differences remained significant.

As the combined type seemed to have the most negative impact on CGAS scores, the symptoms of the combined type were studied in more detail by constructing a factor analysis model of ADHD symptoms. The best-fitting factor model extracted three factors from the childhood ADHD symptoms and four from the adolescent ADHD symptoms. The factors were based on 18 inattentive and hyperactive-impulsive items in the ADHD symptom list in the DSM-IV and were named as follows: the childhood distractibility factor (inattentive items b, h, a, c, see table 2 in page 34), the childhood dreamy factor (inattentive items f, d, e, g, i), the childhood hyperactivity-impulsivity factor (hyperactive-impulsive items a to i), the adolescent distractibility factor (inattentive items b, h, a, c, f), the adolescent dreamy factor (inattentive items d, e, g, i), the adolescent hyperactivity factor (hyperactive-impulsive items a, c, e, d) and the adolescent impulsivity factor (hyperactive-impulsive items b, g, h, i, f). For detailed information about the loadings (i.e. correlations between the item and the factor) see Hurtig et al. (2007). A comparison of the subtypes showed that the children with the combined type had significantly more distractibility symptoms than the inattentive ones (means for sum scores 11.2 vs. 10.1, t 4.126, p<0.001) and more hyperactive-impulsive symptoms than the hyperactive-impulsive ones (means for sum scores 23.3 vs. 22.4, t 2.130, p = 0.036). There were no differences across the subtypes for the dreamy factor, however, and no differences in adolescence. Again, the results were similar for both genders.
Table 7. Means or percentages for the proband and family characteristics between the ADHD subtypes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Combined (n=172)</th>
<th>Inattentive (n=67)</th>
<th>Hyperactive-impulsive (n=67)</th>
<th>Adolescents without ADHD (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>children (n=64)</td>
<td>adolescents (n=30)</td>
<td>children (n=55)</td>
<td>adolescents (n=29)</td>
</tr>
<tr>
<td></td>
<td>mean (SD)%</td>
<td>mean (SD)%</td>
<td>mean (SD)%</td>
<td>mean (SD)%</td>
</tr>
<tr>
<td>Gender, boys</td>
<td>78.1%</td>
<td>73.3%</td>
<td>74.5%</td>
<td>71.6%</td>
</tr>
<tr>
<td>Age of onset of ADHD, yrs</td>
<td>5.1(1.1)</td>
<td>5.1(1.3)</td>
<td>6.3(1.5)</td>
<td>5.8(1.4)</td>
</tr>
<tr>
<td>CGAS at 16 yrs</td>
<td>-</td>
<td>61.4(9.6)</td>
<td>67.2(9.3)</td>
<td>-</td>
</tr>
<tr>
<td>Hyperactivity at 8 yrs</td>
<td>2.8(1.9)</td>
<td>2.8(1.9)</td>
<td>2.4(2.0)</td>
<td>2.2(2.0)</td>
</tr>
<tr>
<td>Family background</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-intact family</td>
<td>23.6%</td>
<td>46.2%</td>
<td>17.0%</td>
<td>33.3%</td>
</tr>
<tr>
<td>family income below average at 16 yrs</td>
<td>-</td>
<td>46.2%</td>
<td>-</td>
<td>45.8%</td>
</tr>
<tr>
<td>attention problems of mothers</td>
<td>27.5(6.1)</td>
<td>27.2(6.6)</td>
<td>-</td>
<td>24.3(6.3)</td>
</tr>
<tr>
<td>attention problems of fathers</td>
<td>28.5(6.9)</td>
<td>26.4(4.2)</td>
<td>21.0(3.3)</td>
<td>-</td>
</tr>
</tbody>
</table>

1 Analysis of variance, p<0.001, post hoc: hyperactive<inattentive, combined<inattentive. 2 Analysis of variance, p=0.023, post hoc: combined<inattentive. 3 Analysis of variance, p=0.016, post hoc: hyperactive<combined. 4 CGAS= Children's Global Assessment Scale (Shaffer et al. 1983), assessment of the adolescent's present overall functioning. 5 Hyperactivity at 8 yrs= mean for the sum scores of the three hyperactivity items on the Rutter B2 questionnaire for teachers (Rutter 1967). 6 Attention problems of parents = mean for the sum scores on the ADHD-IV scale (DuPaul et al. 1998).
5.4 Psychiatric comorbidity of ADHD (III)

The Kiddie-SADS-PL interview identified 105 adolescents with a definite diagnosis of current ADHD (92 SWAN cases and 13 SWAN controls) and 352 adolescents without such diagnosis (172 of them were SWAN controls with no childhood ADHD, and they served as a control group in the analyses). Of the 105 adolescents with ADHD, 76 were boys and 29 girls, while the corresponding frequencies in the control group were 102 and 70. As shown by table 8, the adolescents with ADHD compared to those without had significantly lower CGAS (p<0.001) and had more often CD (28.8% vs. 1.7%, OR 22.84, CI 6.76-77.19), ODD (32.4% vs. 1.1%, OR 40.71, CI 9.52-174.00), substance abuse/dependence (14.3% vs. 3.4%, OR 7.00, CI 2.26-21.72, all to alcohol and four additionally to cannabis), post-traumatic stress disorder (4.8% vs. 0.6%, OR 8.50, CI 0.98-73.79) and depressive disorder not otherwise specified (6.7% vs. 0%, OR 4.65, CI 1.21-17.93) than those without ADHD. Those with ADHD compared to those without also had more often any depressive disorder (18.1% vs. 7.0%, OR 2.95, CI 1.37-6.35) or any DSM-IV disorder other than ADHD (57.1% vs. 21.5%, OR 4.87, CI 2.86-8.27). Table 8 presents the frequencies of the current DSM-IV disorders among the adolescents with and without ADHD.

CD tended to be more common among boys with ADHD (33% of boys and 18% of girls) while ODD tended to be slightly more common among girls (30% of boys and 38% of girls). Substance abuse/dependence was more common among the ADHD boys (16% of boys and 10% of girls), and any depressive disorder was more common among the ADHD girls (16% of boys and 24% of girls), as was also any anxiety disorder (8% of boys and 35% of girls). The adolescents with ADHD and post-traumatic stress disorder were all girls. Fifty-seven percent of the boys with ADHD had any DSM-IV disorder other than ADHD, while the corresponding percentage for girls was 59.

Psychiatric comorbidity was also analyzed among the different subtypes of ADHD. The adolescents with the combined subtype had significantly more CD (30.0% vs. 21.2% for inattentive subtype, 12.5% for hyperactive-impulsive subtype, chi2 9.456, p = 0.009) and ODD (60.0% vs. 20.9% for inattentive subtype, 25.0% for hyperactive-impulsive subtype, chi2 14.687, p = 0.001) than those with the other subtypes. The corresponding percentages for substance abuse/dependence were 23.3% for the combined, 10.4% for the inattentive and 12.5% for the hyperactive-impulsive subtypes, those for any depressive disorder 20.0%, 17.9% and 12.5%, those for any anxiety disorder 20.0%, 11.9% and 25.0% and those for any DSM-IV disorder other than ADHD 70.0%, 52.2% and 50.0%, respectively.
Table 8. Frequencies of DSM-IV disorders among 16-year-old adolescents with and without ADHD.

<table>
<thead>
<tr>
<th>Current DSM-IV disorder</th>
<th>Adolescents with ADHD (N = 105)</th>
<th>Adolescents without ADHD (N = 172)</th>
<th>Fischer’s exact test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internalizing disorders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major depressive disorder</td>
<td>10</td>
<td>9</td>
<td>NS</td>
</tr>
<tr>
<td>Depressive disorder NOS</td>
<td>7</td>
<td>-</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Dysthmic disorder</td>
<td>1</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Adjustment disorder/depression</td>
<td>1</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Bipolar disorder</td>
<td>1</td>
<td>2</td>
<td>NS</td>
</tr>
<tr>
<td>Any depressive disorder</td>
<td>19</td>
<td>11</td>
<td>0.006</td>
</tr>
<tr>
<td>Panic disorders</td>
<td>1</td>
<td>5</td>
<td>NS</td>
</tr>
<tr>
<td>Social phobia</td>
<td>3</td>
<td>6</td>
<td>NS</td>
</tr>
<tr>
<td>Specific phobia</td>
<td>6</td>
<td>9</td>
<td>NS</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>1</td>
<td>6</td>
<td>NS</td>
</tr>
<tr>
<td>Obsessive-compulsive disorder</td>
<td>2</td>
<td>4</td>
<td>NS</td>
</tr>
<tr>
<td>Post-traumatic stress disorder</td>
<td>5</td>
<td>1</td>
<td>0.031</td>
</tr>
<tr>
<td>Any anxiety disorder</td>
<td>16</td>
<td>22</td>
<td>NS</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>1</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Externalizing disorders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct disorder</td>
<td>30</td>
<td>3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Oppositional defiant disorder</td>
<td>34</td>
<td>2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Substance abuse/dependence</td>
<td>15</td>
<td>4</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Tic disorders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourette’s syndrome</td>
<td>1</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Motor tic disorder</td>
<td>3</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Vocal tic disorder</td>
<td>2</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Number of adolescents with CD and ODD</td>
<td>23</td>
<td>-</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Number of adolescents with any DSM-IV disorder other than ADHD</td>
<td>60</td>
<td>37</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

CGAS* = Children’s Global Assessment Scale (Shaffer et al. 1983), assessment of the adolescent’s present overall functioning

5.4.1 ADHD comorbidity in association with symptom severity and family environment

To study the comorbidity and symptom severity of ADHD, a sum variable for ADHD symptoms in the Kiddie-SADS-PL was computed and the means of the sum variable were compared between several mutually exclusive comorbidity groups. The groups were formulated according to ADHD and the most frequent comorbidity. Multiple comorbidities occurred, especially among those with behavioural disorder. As shown in
table 9, the groups included: 1) ADHD alone (n = 56), 2) ADHD and comorbid depression alone (n = 5), 3) ADHD and comorbid substance abuse/dependence alone (n = 3), 4) ADHD and comorbid behavioural disorder alone (n = 20), 5) ADHD and comorbid behavioural disorder and depression (n = 9), 6) ADHD and comorbid behavioural disorder and substance abuse/dependence (n = 8), and 7) ADHD and comorbid behavioural disorder, depression and substance abuse/dependence (n = 4). Most of the adolescents with ADHD and anxiety disorder or post-traumatic stress disorder also had behavioural or depressive comorbidity and were thus included in these comorbidity groups. The means for the number of ADHD symptoms were significantly higher in all comorbidity groups except the groups 2 and 5 (with depression) than that in the ADHD alone group. The means for the number of ADHD symptoms did not differ between those with ODD only and those with both ODD and CD. The adolescents with ADHD and any above-mentioned comorbidity (n = 49, means 11.56 vs. 9.30, t -4.25, p <0.001) had significantly higher means on the sum variable than those with ADHD alone (table 9). The CGAS score was lower among those with ADHD and comorbidity compared to those with ADHD alone. These differences remained significant when boys and girls were compared separately and also when the means for the number of inattentive and hyperactive-impulsive symptoms were compared between the groups.

Closer attention was given to the adolescents with ADHD and any comorbidity in the further analyses. For two logistic regression models, two groups of adolescents were compiled: those with current ADHD alone compared to the SWAN controls with no ADHD ever, and those with current ADHD and psychiatric comorbidity compared to the SWAN controls with no ADHD ever, and the risk to belong to these groups was predicted by different family characteristics (table 10). Family characteristics had scant associations with the ADHD alone group. Only parental feelings of stress were associated with ADHD alone in the offspring, although this variable was also associated with ADHD and comorbidity. In the ADHD and comorbidity group, the logistic regression model revealed significant associations between ADHD and comorbidity and family characteristics. Adolescents living in non-intact families (OR 2.68, CI 1.30-5.56), in families with low income (OR 2.60, CI 1.14-5.95) and with parents whom they reported as showing little interest in their adolescents’ activities (OR 2.82, CI 1.30-6.10) had higher risks for comorbid ADHD. Moreover, the adolescents whose mothers were not satisfied with their life had an over eightfold risk for comorbid ADHD (table 10). Adjustment by gender did not change the statistically significant results.

Information about childhood ADHD and very early onset behavioural disorders was also obtained. For all subjects, the mean age of onset of current or past CD was 13.64 years (SD 1.28) and that of ODD 12.75 years (SD 2.30). No significant associations were found between family type at the age of 7 and the presence of ADHD and comorbid CD/ODD that emerged by the age of 12 years (n = 25).
Table 9. **ADHD, comorbid psychopathology and the number of DSM-IV ADHD symptoms.**

<table>
<thead>
<tr>
<th>ADHD + comorbidity</th>
<th>n (%)</th>
<th>No of ADHD symptoms</th>
<th>p-value**</th>
<th>CGAS* mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADHD alone</td>
<td>56 (53.3%)</td>
<td>9.30 (2.60)</td>
<td>ref.</td>
<td>70.20 (7.80)</td>
</tr>
<tr>
<td>ADHD + MDD/depr. NOS ¹</td>
<td>5 (4.8%)</td>
<td>9.00 (1.41)</td>
<td>NS</td>
<td>66.20 (8.76)</td>
</tr>
<tr>
<td>ADHD + subst. abuse ²</td>
<td>3 (2.9%)</td>
<td>10.67 (0.38)</td>
<td>0.021</td>
<td>68.33 (2.08)</td>
</tr>
<tr>
<td>ADHD + CD/ODD ³</td>
<td>20 (19.0%)</td>
<td>12.05 (2.76)</td>
<td>&lt;0.001</td>
<td>63.65 (9.80)</td>
</tr>
<tr>
<td>ADHD + CD/ODD + MDD/depr. NOS</td>
<td>9 (8.6%)</td>
<td>10.78 (2.64)</td>
<td>NS</td>
<td>55.44 (4.85)</td>
</tr>
<tr>
<td>ADHD + CD/ODD + subst. abuse</td>
<td>8 (7.6%)</td>
<td>11.75 (3.45)</td>
<td>0.020</td>
<td>57.38 (5.29)</td>
</tr>
<tr>
<td>ADHD + CD/ODD + MDD/depr. NOS + subst. abuse</td>
<td>4 (3.8%)</td>
<td>13.75 (3.30)</td>
<td>0.002</td>
<td>50.25 (7.14)</td>
</tr>
<tr>
<td>ADHD + any above mentioned comorbidity</td>
<td>49 (46.7%)</td>
<td>11.56 (2.85)</td>
<td>&lt;0.001</td>
<td>60.21 (8.80)</td>
</tr>
</tbody>
</table>

¹ MDD/depr. NOS = major depressive disorder or depressive disorder not otherwise specified
² subst. abuse = substance abuse or substance dependence
³ CD/ODD = conduct disorder or oppositional disorder or both

* CGAS = Children’s Global Assessment Scale (Shaffer et al. 1983), assessment of the adolescent’s present overall functioning
**Student’s t-test
Table 10. Associations between the risk for ADHD only and the risk for ADHD and comorbidity and family characteristics at the age of 16, reported by parents.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adolescents without ADHD (n = 172)</th>
<th>Adolescents with ADHD alone (n = 56)</th>
<th>Adolescents with ADHD and comorbidity (n = 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Family type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>intact</td>
<td>123</td>
<td>71.7</td>
<td>38</td>
</tr>
<tr>
<td>non-intact</td>
<td>40</td>
<td>24.5</td>
<td>15</td>
</tr>
<tr>
<td>Family income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>below average</td>
<td>55</td>
<td>41.0</td>
<td>16</td>
</tr>
<tr>
<td>average</td>
<td>24</td>
<td>18.0</td>
<td>7</td>
</tr>
<tr>
<td>above average</td>
<td>55</td>
<td>41.0</td>
<td>24</td>
</tr>
<tr>
<td>Adolescent’s report on parents’ interest in adolescent’s activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not at all or seldom</td>
<td>27</td>
<td>16.0</td>
<td>13</td>
</tr>
<tr>
<td>almost always</td>
<td>142</td>
<td>84.0</td>
<td>37</td>
</tr>
<tr>
<td>Mother’s feelings of stress</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no or little stress</td>
<td>71</td>
<td>44.4</td>
<td>12</td>
</tr>
<tr>
<td>some stress</td>
<td>64</td>
<td>40.0</td>
<td>25</td>
</tr>
<tr>
<td>a lot of stress</td>
<td>25</td>
<td>15.6</td>
<td>17</td>
</tr>
<tr>
<td>Father’s feelings of stress</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no or little stress</td>
<td>56</td>
<td>36.8</td>
<td>15</td>
</tr>
<tr>
<td>some stress</td>
<td>69</td>
<td>45.4</td>
<td>15</td>
</tr>
<tr>
<td>a lot of stress</td>
<td>27</td>
<td>17.8</td>
<td>19</td>
</tr>
<tr>
<td>Mother’s satisfaction with life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dissatisfied</td>
<td>7</td>
<td>4.2</td>
<td>5</td>
</tr>
<tr>
<td>neutral</td>
<td>21</td>
<td>12.7</td>
<td>10</td>
</tr>
<tr>
<td>satisfied</td>
<td>137</td>
<td>83.1</td>
<td>39</td>
</tr>
<tr>
<td>Father’s satisfaction with life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dissatisfied</td>
<td>17</td>
<td>11.1</td>
<td>9</td>
</tr>
<tr>
<td>neutral</td>
<td>30</td>
<td>19.6</td>
<td>11</td>
</tr>
<tr>
<td>satisfied</td>
<td>106</td>
<td>69.3</td>
<td>27</td>
</tr>
<tr>
<td>CGAS, mean</td>
<td>82.2</td>
<td>70.3</td>
<td>52</td>
</tr>
</tbody>
</table>

CGAS = Children’s Global Assessment Scale (Shaffer et al. 1983), assessment of the adolescent’s present overall functioning. * OR = odds ratio, CI = confidence interval. Statistically significant associations are given in italics. N’s may vary due to missing information.
5.5 Changes in ADHD subtypes and symptoms from childhood to adolescence (IV)

Figure 2 illustrates the changes that took place in the subtypes of ADHD from childhood to adolescence. Children from all subtype groups showed either remission or persistence of ADHD symptoms. The hyperactive-impulsive children showed remission more often than the children with the other subtypes. Most changes between subtypes occurred among the children with the combined type, who tended to meet only the criteria for the inattentive subtype in adolescence.

The temporal dimension of ADHD symptoms was studied in more detail by dividing the subjects with a childhood ADHD diagnosis into two groups depending on their persistence status (i.e. remitting group or persisting group, table 11). Fifty-eight (41 boys, 17 girls) children with a diagnosis of childhood ADHD experienced remission after childhood, i.e. had no or only some symptoms in adolescence. Of the 105 subjects with persistent ADHD, 75 (56 boys, 19 girls) persisted in the same subtype group, while 30 (20 boys, 10 girls) changed from one subtype group to another upon growing older. There were 15 (7 boys and 8 girls) adolescents in this sample who met the full symptom criteria for ADHD only in adolescence. All of them had three to five symptoms of ADHD before the age 7, and this group was included in the analysis as having a definite diagnosis in adolescence. The adolescents in the persisting group had significantly lower CGAS and more dreamy-like symptoms in childhood and had fathers with more attention problems than the remitting group (table 11). The adolescents in the persisting group also had elevated risks for major depressive disorder (MDD, OR 8.77, CI 1.12-68.50) and ODD (OR 2.39, CI 1.01-5.64) in the childhood period (12 years of age or younger). These patterns were similar in boys and girls.

Fig. 2. Temporal changes of ADHD subtypes from childhood to adolescence
Table 11. Comparisons between the means or percentages of the outcome variables for the groups with remitting and persisting ADHD.

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADHD remitting group</th>
<th>ADHD persisting group</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 58</td>
<td>n = 105</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%/mean (SD)</td>
<td>%/mean (SD)</td>
<td>t, p-value</td>
</tr>
<tr>
<td>Gender, boys</td>
<td>70.7% (9.4)</td>
<td>72.4% (9.7)</td>
<td>0.92 (0.45-1.87)</td>
</tr>
<tr>
<td>Age of onset of ADHD, yrs</td>
<td>5.5(1.5)</td>
<td>5.5(1.4)</td>
<td>-0.182, 0.856</td>
</tr>
<tr>
<td>CGAS at 16 yrs†</td>
<td>73.3(9.4)</td>
<td>65.7(9.7)</td>
<td></td>
</tr>
<tr>
<td>Psychiatric problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood ADHD symptoms‡</td>
<td>10.7(2.8)</td>
<td>11.0(3.6)</td>
<td>-0.695, 0.488</td>
</tr>
<tr>
<td>Hyperactivity at 8 yrs§</td>
<td>2.4(2.0)</td>
<td>2.3(2.0)</td>
<td>0.211, 0.834</td>
</tr>
<tr>
<td>Childhood distractibility*</td>
<td>9.7(2.3)</td>
<td>9.9(2.4)</td>
<td>-0.351, 0.726</td>
</tr>
<tr>
<td>Childhood dreamy§</td>
<td>10.5(3.0)</td>
<td>12.0(2.6)</td>
<td>-3.452, 0.001</td>
</tr>
<tr>
<td>Childhood hyperactivity-impulsivity‡</td>
<td>19.6(5.1)</td>
<td>18.9(5.1)</td>
<td>0.814, 0.417</td>
</tr>
<tr>
<td>Major depression by 12 yrs</td>
<td>1.7%</td>
<td>13.3%</td>
<td>8.77 (1.12-68.50)</td>
</tr>
<tr>
<td>Conduct disorder by 12 yrs</td>
<td>8.6%</td>
<td>16.2%</td>
<td>2.05 (0.71-5.87)</td>
</tr>
<tr>
<td>Oppositional defiant disorder by 12 yrs</td>
<td>13.8%</td>
<td>27.6%</td>
<td>2.39 (1.01-5.64)</td>
</tr>
<tr>
<td>Family background</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-intact family at 7 yrs</td>
<td>21.8%</td>
<td>19.8%</td>
<td>0.88 (0.39-1.99)</td>
</tr>
<tr>
<td>Non-intact family at 16 yrs</td>
<td>36.4%</td>
<td>35.9%</td>
<td>0.98 (0.49-1.96)</td>
</tr>
<tr>
<td>Family income below average at 16 yrs</td>
<td>56.8%</td>
<td>45.6%</td>
<td>0.76 (0.25-2.30)</td>
</tr>
<tr>
<td>Attention problems of mothers§</td>
<td>26.8(6.0)</td>
<td>27.1(6.4)</td>
<td>-0.259, 0.796</td>
</tr>
<tr>
<td>Attention problems of fathers§</td>
<td>24.6(3.9)</td>
<td>26.7(5.5)</td>
<td>-2.133, 0.034</td>
</tr>
</tbody>
</table>

* OR = odds ratio, CI = confidence interval. † CGAS= Children’s Global Assessment Scale (Shaffer et al. 1983), assessment of the adolescent’s present overall functioning. ‡ childhood ADHD symptoms = mean for the sum scores of the DSM-IV childhood ADHD symptoms reported retrospectively. § hyperactivity at 8 yrs= mean for the sum scores of the three hyperactivity items on the Rutter B2 questionnaire for teachers (Rutter 1967). ‣ childhood distractibility = mean for the sum scores of distractibility symptoms, max. 12. ․ childhood dreamy = mean for the sum scores of dreamy symptoms, max. 15. †† childhood hyperactivity-impulsivity = mean for the sum scores of hyperactive-impulsive symptoms, max. 27. 7 attention problems of parents = mean for the sum scores on the ADHD-IV scale (DuPaul et al. 1998). Statistically significant associations are given in italics.
6 Discussion

6.1 Main findings

The main study findings corresponding to the presented aims are:

1. Attention and behavioural problems are common among adolescent boys and girls, especially among those living in non-intact families.
2. Adolescents with ADHD symptoms may consider their physical health and psychosocial well-being poor.
3. The combined subtype is the most impairing and the most severe subtype of ADHD.
4. The most common psychiatric disorders related to adolescent ADHD in Finland are conduct disorder, oppositional defiant disorder, alcohol abuse and depression.
5. Adolescents with comorbid ADHD and behavioural disorder suffer from severe ADHD and live in a family environment that may be detrimental to the optimal development of an adolescent.
6. ADHD is a persistent disorder from childhood to adolescence. Persistence is predicted by early-onset behavioural or major depressive disorders, certain inattentive symptoms and paternal ADHD symptoms.

6.2 Discussion of results

6.2.1 Attention and behavioural problems of adolescents

The epidemiological survey showed that adolescent boys and girls living in other than intact families and adolescent boys living in families with low social status report more attention and behavioural problems than other adolescents. These results confirm earlier findings from the United States (e.g. Biederman et al. 2002, Cuffe et al. 2001, Loeber et al. 1995) and suggest that adolescents in such families have most comorbid attention and behavioural problems, as the correlations between these problems were considerable. The
correlations were also very similar to the earlier findings among adolescents in the general population (Cuffe et al. 2001) and among clinic-referred children with ADHD (e.g. Jensen et al. 1997). The higher prevalence of and correlations between these problems may be due to a lack of sufficient support to the adolescent and problems in limit setting or conflicts in a new situation with (a) new member(s) in the family.

On the other hand, studies conducted in Sweden and Norway have reported that the socio-economic status of the family is unrelated to the psychiatric problems of adolescents (Heyerdahl et al. 2004, Broberg et al. 2001). Finland, like the other Nordic countries, has a relatively high standard of living with social benefits available especially to single-parent and low-income families. One might presume that it is not the social status itself that is related to the attention and behavioural problems of adolescents, but, since ADHD problems may be highly heritable, the common outcomes of ADHD, such as a lack of education and poor social competence, tend to result in a low social status of the families with genetic vulnerability to ADHD.

The mean score of self-reported attention problems among girls in this study is quite consistent with the previous studies conducted in the Nordic countries using the YSR questionnaire (Heyerdahl et al. 2004, Broberg et al. 2001, Helstelä & Sourander 2001). The finding that more girls than boys suffer from these problems is different from the previous findings on children with ADHD, but more consistent with the studies on adolescents. For example, by using the Kiddie-SADS interview, Cuffe et al. found a ADHD prevalence rate of 2.6% among adolescent boys and 0.5% among girls, but if the DSM-III-R criterion of seven years’ age at onset had been excluded, the prevalence rate would have been 3.7% for adolescent girls and 2.9% for adolescent boys (Cuffe et al. 2001). Girls seem to suffer from inattentiveness more often than boys (e.g. Biederman et al. 1995). As inattentiveness may become more apparent at older age (Willoughby et al. 2000), it has been suggested that symptoms of inattention seem to require a later age of onset (Applegate et al. 1997). Consequently, the estimated ADHD prevalence rates among girls in the earlier studies may be inadequate.

Parents, however, report more attention problems in their sons than daughters and less problems in their daughters than the daughters themselves. The associations between attention problems and family variables were quite similar in the SWAN and the YSR measurements, however. It may well be that especially inattentiveness in girls is invisible to parents. Furthermore, boys may not notice their problems or may have difficulties describing their emotions. On the other hand, there may be differences between the genders in dealing with problems: what is an attention problem to a girl may not be an attention problem to a boy. Also, it must be borne in mind that the cut-off points for problems were different in these two questionnaires, and the parents’ questionnaire revealed more severe cases than the adolescents’ questionnaire.

The mean scores of self-reported behavioural problems were surprisingly high among girls in this study. This is not consistent with the previous findings in Europe and in the United States, where boys report more behavioural problems than girls (Verhulst et al. 2003), but is better in accordance with the previous findings in Sweden and Finland (Broberg et al. 2001, Helstelä & Sourander 2001). Girls in the Nordic countries live in a culture where girls are allowed to freely express their emotions, and such behaviours as smoking and alcohol use, for instance, are quite common among girls. Still, especially girls are reared in a way that emphasizes obedience and honesty, and girls may hence be
more honest than boys when reporting truancy and drinking even anonymously. On the rule-breaking behaviour scale, girls scored higher than boys mainly in items concerning truancy, alcohol use and being with older kids. Boys still scored higher in items concerning law breaking and violent acts. On the aggressive behaviour scale, girls scored higher in items concerning aggressiveness that harms more oneself than others, while boys showed an opposite trend. It seems that behavioural problems manifest differently among girls and boys, and that girls suffer from “internalizing domains of externalizing problems”.

The finding that adolescents from very large families have least behavioural problems seems to stem from a cultural background. Very large families are quite common in Northern Finland and they are due to religious reasons rather than poverty and ignorance. Consequently the large number of children in the family is due to strict rules, such as restrictions in contraception in a religious group called the Laestadian Movement. These strict rules also include firm rearing practices and parental emotional involvement, which may in part influence the mental health of the offspring. Earlier findings suggest that middle-born children have most psychiatric problems (Taanila et al. 2004, Richter et al. 1997). These findings seem to be consistent with this suggestion, although the birth order of adolescents in this population had only modest associations with attention and behavioural problems.

### 6.2.2 Psychosocial well-being of the adolescents with ADHD symptoms

The academic performance of children and adolescents with inattention and hyperactivity is often worse than would be expected based on their intellectual capacity (see the review by Hinshaw 1992 and Barkley et al. 1991). The present results seem to be consistent with those previous findings. Adolescents with ADHD symptoms had repeated a grade and attended special school more often than their counterparts. The special schools they attended were mainly for socially inadaptable children. Furthermore, it seems that adolescents with ADHD symptoms dislike going to school, which may naturally be an obvious consequence of poor performance. This reluctance may have long-lasting consequences for their future education and career, as those with ADHD symptoms prefer vocational education to senior secondary school after mandatory school education. After graduation from three-year vocational school career opportunities may still be limited. These results showed that over one third of the adolescents with ADHD symptoms were uncertain about their future education. This seems to indicate a lack of interest in studying among those with ADHD symptoms. It is naturally quite common for 15-year-old adolescents to be uncertain about their future occupation and career. However, 40% of the adolescents without ADHD symptoms aimed to study in senior secondary school and to have thus more opportunities in the future.

Most of the adolescents in this sample reported good physical health, but those with ADHD symptoms reported poor or moderately poor health more often than the others. They also used health care services frequently, which is consistent with the previous findings (e.g. Secnik et al. 2005, Leibson et al. 2001). For instance, the study of Leibson et al. (2001) showed that children with ADHD had more emergency room and hospital
inpatient and outpatient visits than those without ADHD. It seems that, among individuals
with ADHD, frequent use of health care services may begin in childhood and it may
continue in adolescence and adulthood. This is likely to cause an economic burden on
society. In the present study, over a third of the boys with ADHD symptoms had visited a
physician and a school nurse, and half of the girls with symptoms had visited a physician
and two thirds a school nurse twice or more during the last six months. Unfortunately, the
reason for seeking medical care was not inquired. However, boys with ADHD symptoms
may have injuries and accidents requiring medical care more often than their
counterparts. Some visits especially to a school nurse may, however, be due to reluctance
to study and participate in school work.

In adolescence, outward appearance is very important, especially for girls, and affects
the person’s overall life satisfaction. In this study, ten percent of the girls with ADHD
symptoms reported being fairly dissatisfied with life, and nearly a quarter were not
pleased with their appearance, which may cause withdrawal from social interaction with
peers. However, the girls with ADHD symptoms seemed to manage socially better than
the ADHD boys, as they had close friends more often than the boys. Especially boys with
ADHD symptoms may suffer from loneliness. This may result in poor social competence
in those boys and may, later in life, be related to social isolation and dropping out from
the social networks of the community. Nevertheless, the boys with ADHD symptoms
reported being currently satisfied with life more often than the corresponding girls.

Though most of the parents were interested in their adolescent’s activities, there were
some parents of adolescents with ADHD symptoms who were not interested according to
the adolescents’ reports. Though most of the adolescents in this study spent time daily
with their family members and had joint activities with them, and nearly all of them were
naturally living with their parent(s), there were some adolescents with ADHD symptoms
who seldom spent time with their family. Interaction between some parents and
adolescents with ADHD symptoms may be controversial and sometimes even hostile.
Previous results suggest that the families of children with ADHD often feel strained and
experience difficulties in the relationships between the parents and children (Johnston &
Mash 2001). The results of this study may reflect these difficulties. Moreover, as the
etiology of ADHD is highly heritable, parental ADHD symptoms may cause difficulties
when raising a difficult child (Sonuga-Barke et al. 2002). Unfortunately, it was not
possible to assess parental ADHD symptoms in this study.

The results of the latent class analysis seem to be similar to those reported by
Hechtman et al. (1981), who pointed out that hyperactive children approaching young
adulthood can be classified into three groups according to their impairment, i.e. those
whose functioning is fairly normal, those who have more problems than controls and
those with remarkable impairment and problems in many areas. Based on the results of
this study, the first class includes 5.6% of the adolescents with ADHD symptoms who
consider their psychosocial well-being good. They may be comparable to Hechtman’s
group of young adults whose functioning is fairly normal despite their ADHD symptoms.
Class 4 includes 9.7% of the adolescents with ADHD symptoms who consider their
psychosocial well-being poor and have a many ADHD symptoms. They may be
comparable to Hechtman’s young adults with remarkable impairment and problems in
many areas and obviously have severe ADHD. This remarkable impairment may concern
boys and girls alike. Class 3 includes especially boys with ADHD symptoms and no close
friends. They may also have severe ADHD, as their SWAN symptom scores are the highest of all adolescents. Class 2 includes especially girls with ADHD symptoms who have close friends but are dissatisfied with life and their appearance. The adolescents in the classes 2 and 3 may be comparable to Hechtman’s young adults who have more problems than controls.

It seems that adolescents with ADHD symptoms generally manage worse academically and socially than their counterparts, though some of them manage quite well. Moreover, there may be a group of adolescents with ADHD symptoms who consider their physical health and psychosocial well-being much worse than others and have severe problems in school. The factors indicating poor psychosocial well-being; not satisfied with life, not pleased with appearance, no close friend, seem to accumulate in the group of adolescents with more ADHD symptoms. Based on this information, it can be assumed that some of them are at risk for marginalization. These adolescents with remarkable impairment need special attention and support at school and in social interaction with peers and family.

6.2.3 Characteristics of ADHD subtypes

In the clinical part of this study, the ADHD subtypes showed severity differences in childhood that were no longer evident by adolescence. The inattentive type was the most common subtype in adolescence and had a significantly later age of onset than the other subtypes, which is consistent with previous results (Willoughby et al.2000, Applegate et al. 1997), although the age reported is probably the age of symptom recognition rather than the age of onset of ADHD. Children with the combined type may suffer from difficulties in school settings, e.g. there was a difference, though not significant, in teachers’ ratings of the Rutter hyperactivity items at the age of 8. Adolescents’ problems may be due to their inability to meet the social and academic demands posed by the parents and teachers. Moreover, the adolescents with the combined type had fathers with more attention problems than those with other types and nearly half of them lived in non-intact families. Consequently, socio-economic vulnerability may result in severe problems in offspring.

The increased severity of the combined subtype in childhood may be, in part, specific to certain symptoms. For example, children with the combined type of ADHD were significantly more easily distracted, had more difficulties in sustaining attention, were more often reported as not listening and made more careless mistakes than the inattentive children. However, the absence of any difference on the dreamy scale (i.e. items related to difficulties in following instructions and organizing tasks, avoiding tasks, being forgetful and losing things, which are comparable to the SCT items) fails to support the suggestion that inattentive individuals have more SCT-like symptoms than ones with the combined type (Hartman et al. 2004), but rather seems to indicate that the inattentive symptoms of the combined type are more severe than those of the inattentive type. The children with the combined type of ADHD also had significantly more hyperactive-impulsive symptoms than the hyperactive-impulsive ones. Taken together, these findings support the hypothesis that the subtypes reflect quantitative differences rather than being
qualitatively distinct classes, a finding consistent with that reported at the cohort level using the SWAN instrument (Lubke et al. 2007). If ADHD were considered as an extreme along a single continuum, the combined subtype in childhood would reflect the most extreme distribution of symptoms.

As in many previous studies, the hyperactive-impulsive type was the least prevalent subtype, which should be taken into consideration when interpreting these results. On the whole, it seems that the hyperactive-impulsive children and adolescents are the least impaired ones. Moreover, one might presume that the exclusively hyperactive symptoms of children with a lot of energy are more related to temperamental traits than to the ADHD, as suggested by Todd and his colleagues, who introduced a hyperactive-talkative subtype in girls with no impairment (2002).

6.2.4 Psychiatric comorbidity of ADHD

The considerable comorbidity between ADHD and behavioural disorders seen in this study (around 30%) is comparable to the previous results of epidemiologic studies among adolescents (around 50% by Ford et al. 2003, over 20% by Rohde et al. 1999). The two behavioural disorders, i.e. CD and ODD, alone or together, were the most common comorbid disorders among the present adolescents with ADHD. They co-occurred only among those with ADHD. Severe behavioural problems are clearly related to the diagnosis of ADHD. The high comorbidity between adolescent ADHD and behavioural disorders seems to be specifically related to the combined subtype. Behavioural comorbidity also occurred in both genders, as previously reported among clinic-referred children (Faraone et al 2001). Our finding on comorbidity between ADHD and alcohol abuse has also been reported previously (Cohen et al. 1993), as have multiple comorbidities (Ford et al. 2003). Alcohol abuse seemed to be surprisingly common among adolescents with ADHD in this population and it seemed to be related to multiple comorbidities.

Contrary to the previous findings on comorbidity between ADHD and specific emotional disorders, significant comorbidity was found only between ADHD and depressive disorder not otherwise specified. The frequencies of depressive disorders were however, quite low and may therefore cause a lack of statistical significance. Adolescents with ADHD had more often any depressive disorder, however. There were also a bigger proportion of adolescents with major depression in the ADHD group than in the control group. The comorbidity between ADHD and major depression may also become more evident in adult samples. However, similarly to the findings by Ford et al. (2003), nearly all probands with ADHD and major depressive disorder or depressive disorder not otherwise specified also had comorbid CD/ODD. It hence seems that the behavioural comorbidity rather than ADHD alone is related to depression. Moreover, no significant comorbidity between ADHD and anxiety disorders could be found in either gender in this sample (except in the five girls with post-traumatic stress disorder). Probably, ADHD and comorbid anxiety disorders can be seen only among clinic-referred children and the referral is partly due to emotional problems in the first place, or these problems may even
emerge as a consequence of referral. Overall, these results on comorbidity can be
generalized to apply to behavioural comorbidity and, with some caution, to both genders.

As hypothesized, the adolescents with ADHD and comorbid CD/ODD and those with
multiple comorbidities exhibited more ADHD symptoms, i.e. had more severe ADHD,
than those with only ADHD. Similar findings have previously been reported among
clinic-referred children (Connor et al. 2003, Kuhne et al. 1997), and they were now also
verified in a general population. These adolescents also had poorer functional capacity
than those with ADHD alone as measured with the CGAS score. The CGAS score
naturally has a linear relationship with the number and severity of psychiatric problems,
but it also reflects the degree of functional impairment. However, there is no linear
relationship between comorbidity and the number of ADHD symptoms among those with
no diagnosis of ADHD or even among those sub-threshold cases who lack one symptom
of the definite diagnosis. It seems that comorbidity is related to the number of symptoms
that yield a diagnosis of ADHD. Multiple comorbidities included at least CD or ODD in
every case. There were no differences in the severity of ADHD between those with
comorbid CD and ODD and those with only comorbid ODD. It seems that ODD, which
is sometimes considered a milder disorder than CD, is as severe as CD when ADHD is
present. However, those with ADHD and comorbid depression had fewer ADHD
symptoms than those with other comorbidities. It seems that comorbid depression is not
related to the severity of ADHD. Moreover, some inattentive symptoms may actually be
symptoms of depression rather than of ADHD. On the whole, it seems that ADHD with
behavioural disorder is the most severe form of ADHD.

### 6.2.5 Comorbidity of ADHD in relation to family environment

Family environment contributed to the risk for comorbid ADHD in adolescents,
especially those living in non-intact or low-income families. These socio-economic
factors seem to be related to the onset of behavioural problems, although the relationship
cannot be considered as causal. Also, the lack of parental interest in adolescents’ activities
and the presence of maternal life dissatisfaction increased the risk for comorbid ADHD in
adolescents. None of these associations was significant in the ADHD alone group
compared to the control adolescents without ADHD. Moreover, there were no significant
differences in the parents’ interest in the adolescent’s activities between the adolescents
with and without ADHD symptoms in the whole cohort (see table 6). Also, interestingly,
the association between family type at the age of 7 and ADHD and very early onset
comorbid behavioural disorder was not significant, although it should be pointed out that
the number of those children was small (n = 25). Consequently, the risk for comorbid
ADHD may increase over time for those living in vulnerable environments. Also,
multiple comorbidity seems to constitute a complex cluster for some adolescents, with
the family environment making significant contributions. The five girls with post-
traumatic stress disorder serve as an example: with lifetime ADHD and comorbid
adolescent behavioural disorder, all have suffered from major depression and witnessed
long-term domestic violence or violent acts in the neighbourhood.
However, genetic factors also contribute to vulnerabilities in the family environment. Severe parental ADHD symptoms may lower the parents’ educational achievements and their impulsivity and “hot temper” may result in difficulties in holding a job and strained in marital relations. Consequently, there may be more low-income or more divorced or remarried parents with ADHD symptoms in this sample than those without symptoms. Accordingly, the ADHD symptoms of their offspring may stem from a genetic origin.

6.2.6 Changes in ADHD symptoms and subtypes from childhood to adolescence

About two thirds of the ADHD children continued to have the diagnosis in adolescence, which is consistent with previous findings (Biederman et al. 1996, Barkley et al. 1990). Persistence of ADHD into adolescents was predicted by certain inattentive symptoms in childhood, early-onset depression or oppositional defiant disorder and attention problems in fathers, which is consistent with the findings reported among clinic-referred children (Biederman & Faraone 2002). Obviously, at least in some cases ADHD is an inherited lifetime disorder, but psychiatric comorbidity may also contribute to the risk for persisting ADHD. The adolescents who persisted with the diagnosis had more dreamy symptoms (difficulties in following instructions and organizing tasks, avoiding tasks, being forgetful and losing things) in childhood than those who remitted the diagnosis, which may reflect the cognitive endophenotype of working memory (Loo et al. 2007).

Other studies have reported persistence of ADHD especially in individuals with the inattentive type (e.g. Gaub & Carlson 1997), which may reflect the close relationship of certain inattentive symptoms with persistence. Consequently, it seems that the subtypes of ADHD may be less significant with respect to persistence but that specific inattentive symptoms may be more important. These results also show that all ADHD symptoms can change over time and development although the majority of those who moved from one subtype group to another upon growing from childhood to adolescence moved from the combined type to the inattentive type. These findings are consistent with the findings of Clarke and his colleagues, who reported neurophysiological evidence for a maturational lag underlying not merely hyperactive symptoms but also some inattentive symptoms (Clarke et al. 2001, 2002). They are also consistent with the findings reviewed by Faraone et al. showing remission of hyperactive symptoms (2006).

The remitting hyperactive-impulsive symptoms in some children may actually be symptoms of other behavioural problems and not ADHD symptoms at all (i.e. ADHD-like symptoms). These individuals may be “difficult children”, who are hard to manage by care providers because of their temper tantrums and oppositional behaviour, but adopt more appropriate behaviour when growing older. That might explain the finding that hyperactive-impulsive symptoms remitted totally more often than symptoms of the other subtypes. In some cases hyperactive-impulsive symptoms might be caused by a difficult temperament or childhood depression, as sadness may manifest as irritability in young children (American Psychiatric Association 1994). Consequently, a diagnosis of ADHD should be set cautiously after a comprehensive examination of the child and the family. This should be especially so in the case of pre-schoolers.
6.3 Discussion of the diagnosis of ADHD

In spite of massive research work, the diagnosis of ADHD is still a source of controversy in many ways. Although there is consensus between several researchers on the genetic origin of ADHD (Barkley 2002) there are also opposite views. For example, Timimi et al. (2004) and Kärfve (2000) concluded that the symptoms of inattention and hyperactivity emerge from the social constructs of modern society. However, the development of a child is always unique and dependent on personal characteristics, and it is always shaped by environmental factors. Hyperactivity is a common feature among young children in general, and whether or not a symptom of ADHD, it may decrease when the child grows older as a consequence of demands by parents and teachers. Based on the results of this thesis, hyperactivity symptoms remitted or decreased after childhood in many individuals. Although ADHD is a genetic disorder, its symptoms may thus change after childhood. This change may be associated with the child’s environment. Moreover, a good and supportive family environment may not only protect a child from the comorbidity of ADHD and behavioural disorder, but may also protect a child from ADHD itself. All in all, it seems that ADHD is a true neuropsychiatric disorder with childhood onset in a considerable number of children and adolescents. However, the onset criterion of the age of seven years should be reconsidered, as some inattentive symptoms seem to become apparent at older ages.

6.4 Discussion of the methods used

The NFBC 1986 ADHD study was the first that used the SWAN questionnaire in an epidemiological study in Finland. The newly developed SWAN questionnaire has not yet been validated in Finland, and its psychometric properties have not been studied yet. However, the reliability of the SWAN ADHD scale was excellent (0.96) when measured with Cronbach’s alpha coefficient (Cronbach 1951), which is used to test the internal consistency of the scale. As presumed on the basis of the literature, the Finnish mean for the ADHD scale was lower for both genders than that reported by Swanson and colleagues (Finnish mean -0.97 for boys and -1.24 for girls vs. Swanson’s mean in the United States -0.45, Swanson et al. 2001a,b). However, it turned out during the clinical study that the sensitivity and specificity of the SWAN questionnaire may not be very good in this population, because there were some adolescents with the diagnosis of current ADHD in the SWAN control group and ones without the diagnosis in the SWAN case group.

The YSR questionnaire, which is frequently used both in clinical and in research work in Finland, is still undergoing validation. That is why the cut-offs proposed by Achenbach were used in this study. The reliabilities of the YSR scales were not as good as that of the SWAN ADHD scale, as Cronbach’s alpha coefficients were 0.69 for the attention problems scale, 0.68 for the rule-breaking behaviour scale and 0.84 for the aggressive behaviour scale. It seems that especially the attention problems and the rule-breaking scales include items that measure other problems. The YSR questionnaire on the whole may be quite long (113 items) to read and complete for a very restless adolescent. In this
study, the adolescents completed the whole questionnaire, although only three scales were used in the analyses.

The Kiddie-SADS-PL semi-structured psychiatric interview is not a frequently used research tool in Finland, and there is no country-specific validation available about the prevalence of various disorders among the general population. However, the author found it an excellent method for assessing behavioural and emotional disorders in the general population because of its clear and numerous descriptions and examples of symptoms, which are directly comparable to the symptoms of disorders in the DSM-IV. The percentages for inter-rater agreement in this study were quite comparable to those reported by Kaufman et al. (1997), ranging from 92% to 100%, mean 96%, for the diagnoses (Kaufman’s range 93% to 100%, mean 98%). The kappa values (0.70 for ADHD, 0.77 for other diagnoses) for the diagnoses based on the Kiddie-SADS-PL were quite good according to the interpretation by Landis & Koch (1977). They suggest the following benchmarks: below 0.50 poor, 0.51-0.60 slight, 0.61-0.70 fair, 0.71-0.80 moderate, 0.81-0.90 substantial and 0.91-1.00 almost perfect (Landis & Koch 1977). The inter-rater reliability of the Kiddies-SADS-PL-diagnoses can be thus considered sufficient.

The CGAS scores worked well in this study. They seemed to discriminate well between adolescents with functional impairment and those without. There was a linear relationship between the number and severity of psychiatric problems and the CGAS score, but the CGAS score also reflected dysfunction in the domains of e.g. social interactions. The simplicity of use of the CGAS makes it an excellent method to assess the overall functioning of an adolescent.

6.4.1 Strengths of the study

This homogenous study population of a prospective mother-child birth cohort, which can be considered a representative sample of adolescents in Northern Finland, gave a good opportunity to study attention and behavioural disorders among adolescents. With the representative data sets and the high attendance at the different stages, an extensive data pool has been collected prospectively during pregnancy, at birth, at ages 7-8 years and at ages 15-18. The particular value of cohort studies in general is in their detailed data on family and social circumstances and the development and health of the children and their parents. As an epidemiological survey, this cohort data made it possible to follow, for instance, the development and effect of attention and behavioural problems on the individual level from age 8 to 15-16 years. Moreover, as for ADHD itself, this cohort data is unique in the western world: it is one of the largest non-medicated study populations with ADHD (only one boy had received methylphenidate medication for his ADHD). The clinical interviews of the adolescents and their parents drawn from the cohort gave reliable and detailed information about the psychiatric status of Finnish adolescents. The present study is one of the first studies that evaluated psychiatric disorders among a large number of adolescents in Northern Finland. Usually, adolescents are included with children in studies in the field of child psychiatry. Consequently, the characteristics of psychiatric problems specific to adolescence may remain unrecognised. By focusing on
adolescents, this study gave valuable information about ADHD and behavioural disorders in this phase of life where symptoms of various psychiatric disorders may even increase because of the adolescent turmoil.

6.4.2 Limitations of the study

There are several limitations in this study. In the epidemiological part (I, II) one of the limitations is that there were more boys (and their parents) than girls who did not fill in the questionnaire properly or did not complete it at all. The response rate for boys was lower than that for girls in the YSR and SWAN questionnaires. One might presume that there are more attention and behavioural problems among boys than is shown by the results in this study. It is also quite obvious for both genders that adolescents with severe problems in concentrating seldom manage to voluntarily complete a questionnaire with almost two hundred items concerning their physical and mental health. Consequently, some adolescents with severe ADHD symptoms might have been missed. The results indicated that those boys and girls who failed to fill in the YSR questionnaire had more attention problems in the SWAN than those who filled in the YSR.

In the clinical part of this study (III, IV), one of the limitations is the retrospective assessment of childhood ADHD (Kiddie-SADS-PL past diagnosis) by the parents and the adolescents which may have resulted some recall bias. Familiality in the etiology of ADHD may also result in bias if the parents with ADHD symptoms either under- or overreport those symptoms in their offspring. Faraone and colleagues reported, however, that parental ADHD symptoms do not bias maternal reports of ADHD symptoms in their children (2003a). The third limitation is the relatively high dropout rate (55% of SWAN cases and 63% of SWAN controls participated). The participants and the dropouts did not differ in their ADHD symptoms, however. Still, some of the results in this study should be interpreted with caution. The fourth limitation is the small sample sizes in the different categories: especially the number of girls was quite small in this study, and some of the results should not be generalized to the whole population. The fifth limitation is the timing of the epidemiological survey. These adolescents were 15 years old when their parents assessed their current ADHD symptoms with the SWAN questionnaire. Consequently, part of the adolescents whose symptoms had remitted after childhood were not screened as cases, and we might therefore have missed them in the clinical part of this study. Some of them were probably included as controls, however. That might be one of the reasons why ADHD-affected probands were also found in the SWAN control group in the clinical study. Unfortunately, the timing of the remission of ADHD symptoms could not be determined with the study design used and further research on this issue is therefore needed.

Lastly, a major limitation is the lack of teachers’ evaluation of the adolescents’ attention problems. Teachers were sent questionnaires during the clinical study, but quite a small proportion of them were returned. In addition, several questionnaires had a note saying that the teacher had not learned to know this particular student very well. Adolescents in secondary school, in senior secondary school and in vocational school have several teachers during the school day, and the teachers may not get to know their
students very well. Consequently, the information from the teacher could be unreliable and their evaluations were not used in the adolescent phase. However, teachers’ evaluations of hyperactive symptoms in the childhood phase (Rutter B2) were used in the clinical study.
7 Conclusions

7.1 Main conclusions

In conclusion, attention and behavioural problems are quite common among Finnish adolescent boys and girls, especially among those living in non-intact families. The clinical diagnosis of ADHD is quite persistent from childhood to adolescence. This persistence may occur in every subtype of ADHD. Persistence is predicted by early-onset behavioural or depressive disorder and paternal ADHD symptoms as well as certain inattentive symptoms. In general, comorbid ADHD (and specifically the combined subtype of ADHD) and conduct or oppositional defiant disorder is a severe form of ADHD. Adolescent ADHD with comorbid behavioural disorder may sometimes be a distinct form of ADHD, but the onset of behavioural disorder may also be related to adversity in the family environment. While the genetic factors and environmental risk factors interact in the onset of ADHD, family characteristics may contribute to the comorbidity between ADHD and behavioural disorder. These findings suggest that ADHD with behavioural comorbidity in adolescence may have multiple etiologies: genetic and also environmental. Earlier studies of psychosocial adversity in family environment and ADHD may be more related to the comorbid condition of ADHD and behavioural disorder than to ADHD itself. Naturally enough, ADHD itself causes impairment to the individuals suffering from this disorder as, according to self-reports, some adolescents with ADHD symptoms considered their physical health and psychosocial well-being quite poor. Factors indicating poor psychosocial well-being may accumulate for those with a lot of ADHD symptoms. This may lead to marginalization of especially boys with ADHD symptoms.

7.2 Risk and protective factors in the framework of the family system

The family seen as a system is a fruitful approach to mental health research. The persons in the family interact with each other and each person makes unique contributions to the functioning of the system. Parents are also influenced by their previous family systems.
ADHD symptoms of children or parents may start a chain of negative interaction in the family system. Adolescence, in general, is a sensitive phase of life, where family bonds are not as tight as in childhood. The microsystem of an adolescent still includes parents as important persons influencing the adolescent’s life. Although gaining independence is important, all adolescents and especially those with ADHD do need emotional involvement by and support from their parents. Without that support, they may be at risk to develop comorbid behavioural disorder. However, some parents are unable to give that support, partly because of their own problems. Parents’ attention problems, other mental problems or problems in marital life may thus interfere with secure parenting. The adolescent’s temperament and personality are also involved in perceived support: the fact that some adolescents feel that their parents are not interested in their activities may actually be a consequence of managing with a difficult adolescent with ADHD and comorbid conditions. The adolescent’s microsystem also includes close friends. Those with ADHD symptoms may not profit from the social support of friends because of their poor social skills or rejection by other adolescents.

The author identified some risk factors in the family environment that may contribute to the comorbidity of ADHD and behavioural disorder and also some factors that may protect an adolescent with ADHD from behavioural disorder. The risk factors identified in this study included living in a low-income family, father’s attention problems, parents’ non-interest in adolescent’s activities and mother’s dissatisfaction with life, and they can be considered as correlates described by Kazdin et al. (1997). These risk factors are associated with an increased likelihood of the outcome, i.e. the condition of comorbid ADHD and behavioural disorder. Since this study design was mainly cross-sectional, however, no directional relation can be determined. Moreover, these risk factors cannot be considered as markers or causal risk factors because the outcome is not limited to ADHD and comorbid behavioural disorder, partly because of adolescents’ capacity for resilience. Paternal attention problems may, however, be related to the genetic transmission of a certain type of ADHD. That type might be more vulnerable to the development of comorbid behavioural disorder because of an unstable family environment caused by paternal attention problems. Some of these risk factors, such as living in a low-income family and mother’s dissatisfaction with life are comparable to the psychosocial adversity factors found by Rutter et al. (1975), which are related to the onset of mental problems in general. In this population, they were related especially to ADHD and comorbid behavioural disorder.

There are also some protective factors that may protect an adolescent with ADHD from comorbid behavioural disorder, such as living in an intact family or in a very large family. Intact family is probably the most important protective factor against ADHD with comorbid behavioural disorder, as nearly all very large families were also intact families in this population. Furthermore, it may be the emotional involvement and the firm rearing practices in very large families that matter rather than the size of the family itself. However, the results concerning very large families can be generalized only in this population.

Although possessing potential genetic vulnerability to ADHD, adolescents in intact families are likely to benefit from the social interactions and emotional involvement offered by their families. At their best, families with both biological parents may have long-lasting emotionally affectionate bonds between the parents. Adolescents in these
families may feel themselves more secure and more loved than adolescents in families with separated parents or with changing step-parents. One might also presume that there is more time for adolescent in families with two biological parents who are committed to family life. Parents may also feel more relaxed when there are two of them to share the financial and other burdens of raising a family. In very large families, however, parents have limited time to spend with each child. Especially mothers have to take care of the babies of the family. Consequently, the company of fathers and siblings play an important role in the well-being of adolescents in these families. The closeness of siblings in large families may be very concrete: they have to share a room or some sporting equipment in spite of the government benefits for these families. On the other hand, it may be relevant to consider the birth order of the adolescent in a very large family. Those who are born first or second usually have to take care of their little siblings when growing older. In adolescence they may feel being parents to their little siblings. Those who are the last children in the family may benefit from the company of their elderly parents and consider their adult sibling as another parent.

However, intact families and very large families seem to be able to offer those stable affectional relationships and positive experiences that Rutter (1993, 1987) found so important in strengthening individuals’ capacity for resilience. When considering the family life cycle and the phase with adolescents in the family, resilience against mental problems in adolescence stems from the parental emotional involvement that begins in early childhood and continues through the difficult years of adolescence. In spite of the ADHD problems of their adolescent, some families manage to solve successfully the emotional and relational challenges, the closeness and the distance, in this phase of family life cycle. Or, like some parents pointed out during the clinical interview: “we try to keep in touch with our adolescent even when nothing seems to go right”.

7.3 Implications of the study

The results of the present study show that ADHD is most severe when comorbid with behavioural disorders even among adolescents in the general population. With the considerable risk for comorbidity, adolescents with ADHD also need evaluation in the family environment in order to receive sufficient support for their healthy development. However, ADHD symptoms themselves may interfere with individuals’ academic performance and social relations and even with their perceptions about their physical health. These adolescents with remarkable impairment need special attention and psychosocial support at school and in their social interaction with peers and family to avoid marginalization. ADHD is generally quite persistent from childhood to adolescence, and especially the dreamy-like symptoms seem to be stable across age. However, ADHD may occasionally be a transient disorder in childhood with minor impairment. Therefore, ADHD as a disorder has a developmental aspect as well. Psychosocial interventions could possibly strengthen this development and help children with ADHD symptoms to function better in their environment. Moreover, the treatment of ADHD should focus on strengthening the individual’s resilience in order to prevent comorbid behavioural problems, as comorbidity seems to be related to psychosocial
adversity. Before any interventions, it is essential to study carefully the individual symptom pattern of this disorder. Especially children with the combined type of ADHD need special attention in clinical settings because they have severe distractibility symptoms that may lower their academic achievements, and they are at major risk to develop comorbid behavioural disorders in adolescence.

7.4 Future research

A set of prospective birth cohort data enables a longitudinal study design. As this study design was mainly cross-sectional, longitudinal research is needed to detect the risk and protective factors in the family environment in early childhood and their impact on individual development later in life. In addition to important follow-up studies on ADHD in adulthood and even at old age, researchers should investigate the complexity of the comorbid condition of ADHD and behavioural disorder. It may be relevant always to include comorbidity when studying ADHD. This study failed to find comorbidity between ADHD and anxiety disorders. However, in earlier studies this condition has been well recognised among clinic-referred children. Researchers could try to replicate the earlier findings with a different study population in Finland. This study showed some comorbidity between ADHD and depression, especially among girls. This finding should be replicated with a different population or with the same population in adulthood, as depression is nowadays a common disorder in Finland. Parenting and pre-school children with ADHD is another issue that is quite unknown in Finland. The study of parenting practices with a difficult child may help the personnel in well-baby clinics to develop patterns of sensitive parenting and better understanding between parents and difficult children. It would be most interesting also to study the rearing practices in very large, religious families and the mental problems in the offspring of those families. It is also most important to study the emotions and perceptions of self among children, adolescents and adults with ADHD. The results of this study showed that adolescents with ADHD may feel themselves inferior to others. ADHD that persists into adolescence and adulthood is a condition that has major impacts on several aspects of life among individuals. Therefore, interdisciplinary studies and collaboration between medical research, education and social sciences are needed.
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