

NORWEGIAN UNIVERSITY OF LIFE SCIENCES



**ADHD with co-occurring depression/anxiety in children: the relationship
with somatic complaints and parental socio-economic position**

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Summary

The need for continued research of the development of child mental health problems is considerable, as child mental health often precedes the development of mental disorders later in life. Attention-Deficit/Hyperactivity Disorder (ADHD) is the most frequently diagnosed and impairing neurobehavioral disorder in children. The consequences of ADHD are more detrimental in lower socio-economic levels, and the diagnosis is often co-current comorbid with other mental disorders.

The aim of the present study was to identify the prevalence of ADHD with or without co-occurring depression/anxiety, and examine whether ADHD can be associated with somatic complaints. We also wanted to examine whether a low parental Socio-Economic Position (SEP) was related to ADHD alone, or when co-occurring with depression/anxiety.

Data for this study is collected from the Akershus health profile, a survey conducted in 2002. ADHD and depression/anxiety were measured with the Strengths and Difficulties Questionnaire filled in by the children's parents. Somatic complaints was measured by frequency of the child reporting headache, abdominal pain and neck pain, and SEP was measured by the household income and education level of the parents.

Analyses showed that somatic complaints in children with ADHD, may be a symptom of co-current comorbidity of depression or anxiety. We also found an inverse relationship between low parental SEP and prevalence of both ADHD and depression/anxiety in children. The results from the present study may improve strategies to detect ADHD, with or without depression/anxiety, at an early stage and thus possibly intervene in a more appropriate way.

Sammendrag

Behovet for forskning innen psykiske helseproblemer hos barn er betydelig. Den psykiske helsetilstanden hos barn, legger i stor grad grunnlaget for utviklingen av psykiske lidelser senere i livet. Attention-Deficit/Hyperactivity Disorder (ADHD), er den hyppigste diagnostiserte atferdslidelsen hos barn. Konsekvensene av å ha ADHD, og prevalensen, viser seg å være større i for de i lav sosioøkonomisk posisjon, og lidelsen er ofte komorbid med andre psykiske lidelser.

Målet med denne studien var å identifisere prevalensen av ADHD med eller uten sammenfallende depresjon/angst, og se om ADHD kan være assosiert med somatiske plager. Vi ønsket også å se om lav sosioøkonomisk posisjon hos barnets foreldre var assosiert med ADHD alene, eller i en komorbid tilstand med depresjon/angst.

Datamaterialet for denne studien er hentet fra helseprofil for barn og unge i Akershus, en kartleggingsstudie som ble gjennomført i 2002. ADHD og depresjon/angst ble målt ved hjelp av Strengths and Difficulties Questionnaire, som ble fylt ut av barnets foreldre. Somatiske plager ble målt ved hjelp av rapportert hyppighet av hodepine, magesmerter og nakkesmerter, og sosioøkonomisk posisjon ble målt ved hjelp av inntekt i husholdningen og utdanningsnivå til foreldrene.

Analysene viste at somatiske plager hos barn med ADHD, kan være et symptom på komorbiditet med depresjon eller angst. Vi fant også en sammenheng mellom lav sosioøkonomisk posisjon hos foreldre og økt forekomst av ADHD og depresjon/angst hos barna. Disse resultatene kan bidra til å forbedre strategier, slik at det er mulig å tidligere oppdage ADHD, med eller uten depresjon/angst, hos barn og sette i gang tiltak for å fremme, forebygge og behandle mental helse hos barn på en mer hensiktsmessig måte.

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For any errors or inadequacies that may remain in this work, the responsibility is entirely my own.

Oslo, May, 2012

Maria Jensberg Leirbakk

Abbreviations

ADHD/ADHD-C	Attention-Deficit/Hyperactivity Disorder (Combined type)
ADHD-PI	Attention-Deficit/Hyperactivity Disorder Predominantly Inattentive type
ADHD-PH	Attention-Deficit/Hyperactivity Disorder Predominantly Hyperactive-impulsive
SEP	Socio-Economic Position
SDQ	Strengths and Difficulties Questionnaire
DSM-IV	Diagnostic and Statistical Manual of mental disorders, fourth edition
CBCL	Child Behaviour Check List
WHO	World Health Organization

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1. Introduction

1.1 The diagnosis Attention-Deficit/Hyperactivity Disorder

Sir Alexander Crichton was the first to describe a disorder that appears to be similar to Attention-Deficit/Hyperactivity Disorder (ADHD) in 1798 (Crichton 1798). Since then, the symptoms of ADHD have been given many names “minimal brain damage/disorder or dysfunction”, “hyperkinetic reaction of childhood”, “learning and behavioural disabilities”, “hyperactivity”, “attention-deficit disorder with or without hyperactivity”, “hyperkinetic disorder”. The Diagnostic and Statistical Manual of Mental Disorders, 3rd edition, Revised (DSM-III-R) from 1987 was the first to use the name ADHD. The last major revision of DSM, DSM-IV from 1994, contains the most common clinical scale for diagnosing ADHD. This scale consists of 18 behavioural items, and distinguishes between three ADHD subtypes. A predominantly hyperactive-impulsive type (ADHD-PH) is diagnosed when at least six items are selected from the hyperactive-impulsive dimension, a predominantly inattentive type (ADHD-PI) is diagnosed when at least six items are selected from the inattentive dimension, and a combined type (ADHD-C) is diagnosed when at least six items are selected from each of the two dimensions (ADHD-C, is the diagnosis referred to when the name ADHD is used in this thesis). For all three subtypes, persistency for at least 6 months is required, and age of onset before 7 years. Further, the DSM-IV requires the symptoms to cause clear and significant impairment in at least two settings: school, friends, family, or work, and clear evidence that the symptoms interfere with or reduce the quality of social, academic, or occupational functioning. The symptoms must not occur in the course of other mental disorders (American Psychiatric Association 1994). Proposed revisions of the DSM-V, to be released in May 2013, are to lower the criteria by changing the age of onset to “before the age of 12”, and fewer symptoms required for a diagnosis of adult ADHD (American Psychiatric Association 2010).

1.2 The burden of ADHD

ADHD is the most common, and yet impairing neurobehavioral disorder in children, globally affecting 3-5 % of children, boys more frequently than girls (American Psychiatric Association 1994). It is a controversial diagnosis with no single cause, and no blood sample to

diagnose the disorder. However, the disorder is highly heritable with an estimated average heritability from a parent of 57 %, and if a sibling is diagnosed, a possibility of 32 % that another child in the family also may have the disorder (Biederman et al. 1995). ADHD has a complex mode of inheritance, involving interaction of genes and environmental risk factors (Buitelaar 2005). Although the exact aetiology and neurobiological substrate of ADHD remain unclear, converging evidence suggests that abnormalities in brain structure, as well as functioning, might play an important role in the path physiology of the disorder. In a recent review by van Ewilk and colleagues (2012), they found fairly consistent image of specific abnormalities in white matter integrity in individuals with ADHD. There have, in addition, been found an association between mothers who used tobacco products or alcohol during their pregnancy, and the development of behaviour and learning problems in their children. Lead exposure and hyperactivity has implied a similar association, especially when the lead exposure occurs within the first three years. Nicotine, alcohol, and lead can be toxic to developing brain tissue, and may have effects on the behaviour of the children exposed to these substances at early ages. However, it is unlikely that such exposure accounts for differences in brain development in the vast majority of children and adolescents with ADHD (Biederman et al. 1990).

Children with this diagnose often struggle with under-achieving in school, family- and peer-related problems, and an increased anti-social behaviour (Danckaerts et al. 2010). Most children are diagnosed at age 8-9, with a history of symptoms for several years. On average, it takes four years from parents report their concern, and a possible diagnosis is given (Mathiesen et al. 2009). Unfortunately this “laid-back” attitude allows room for many children with the disorder to develop significant additional problems.

The heterogeneity of ADHD is a challenge. Other disorders often co-occur as a consequence of underlying ADHD. Conduct disorder, anxiety, depression, and oppositional defiant disorder affect from 15 to 75 % of the children (Costello et al. 2003b; Fleitlich-Bilyk & Goodman 2004). For a long time ADHD was seen as a childhood disorder, and the fact that this disorder in many cases persists into adulthood was disregarded (Simon et al. 2009). Despite a decline of some ADHD symptoms over time, the functional impairment often remains (Biederman et al. 2000; Rasmussen & Gillberg 2000). This is an important aspect, regarding an understanding of the developmental course of ADHD. Recent estimates of the prevalence in the adult population is from 2.4 to 6.6 %, implying that there are about 19 million adults living in the European Union suffering from ADHD (Franke et al. 2010). Outcome includes an increased risk of substance abuse, accidents and criminal activity,

adverse health, lower occupational functioning, and family dysfunction with an increased rate of divorce (Danckaerts et al. 2010). In a white paper for the EU, the direct medical costs for adult ADHD are calculated to be 46 billion Euro each year, and lost work performance costs 17 billion Euro annually (EU 2010). In addition there are high costs for crime, accidents and divorce, but there are no representative studies available concerning this cost to the society.

1.3 Depression and anxiety in children

The most common mental disorder in childhood is depression and anxiety (Costello et al. 2003b). There is a high degree of comorbidity between the two disorders, and 40 % of children diagnosed with depression are comorbid with anxiety, and 20 % of children diagnosed with anxiety are comorbid with depression (Avenevoli & Steinberg 2001). Older children with anxiety disorder or depression do report higher levels of impairment than younger children (Kendall 1994), indicating an increase in severity of the disorders with age. The causes of anxiety and depression in children and adolescents are complex, but one imagines that congenital characteristics of the child interacts with the developmental environment and life experience (Mathiesen et al. 2009).

Heiervang and colleagues (Heiervang et al. 2007) concluded in his epidemiological survey of Norwegian 8-10 year olds, that emotional disorders such as depression and anxiety are a neglected burden to children's well-being. The nature of the disorders, of being less disruptive and therefore less likely to come to attention, delays the time between onset and treatment. Only 13.3- 29.4 % of the children with an emotional disorder in their survey had been in contact with school psychology-, school health- or mental health services. This is in accordance with the literature assuming that parents seek treatment for a child who acts outwardly or behaves aggressively, and overlooks a child who withdraws socially (Kendall 1994). Early detection and intervention is effective in ameliorating the poor psychosocial outcome. Psychotherapy is an appropriate treatment for all children and adolescents with depressive disorders. Antidepressants may prove useful in some cases, and are especially recommended for patients with severe depression (Birmaher et al. 1998).

Among the different types of anxiety disorders, there are some common features, but they are differentiated by the focus of the child's fears. There are seven specific anxiety disorders: separation anxiety disorder, generalized anxiety disorder, social anxiety disorder (social phobia), panic disorder, panic disorder with agoraphobia, obsessive compulsive

disorder, and specific phobia (American Psychiatric Association 1994). Even though the specific type of anxiety varies, the estimated prevalence of anxiety in childhood is 20 %. About half of these will experience severe functional impairment due to anxiety (Merikangas 2005). Long-term outcomes of the disorder implies a negative impact, often caused by isolation, on social adjustment and academic work (Strauss et al. 1989).

Depressive disorders have two major subtypes: major depressive disorder, which consists of a single episode or recurrent episodes of depression, and dysthymia, marked by chronic disturbance of mood (American Psychiatric Association 1994). Both disorders are characterized by severe mood disturbances, which involve feelings of sadness, loss of interest or pleasure, sleeping problems, loss of appetite and concentration.

In children and adolescents, depression is often expressed through irritable mood instead of sadness (Mathiesen et al. 2009). Notable 5 % of Norwegian children, have pervasive symptoms of depression, enough to be diagnosed with the disorder. Additionally 15-20 % have severe symptoms of depression, but not enough burden and symptoms to be diagnosed (Wichstrom 1999). Depression in children and adolescents is associated with an increased risk of illness along with interpersonal and psychosocial difficulties that can persist long after the depressive episode is resolved. In adolescents, depression is associated with an increased risk of substance abuse and suicidal behaviour. Opinions differ regarding treatment planning and duration of treatment required. It is crucial for a successful outcome to develop a treatment relationship with the patient and family (Birmaher et al. 1998).

1.4 Somatic complaints

Children with anxiety disorder and depression often express their disorder through somatic complaints such as chest pain, abdominal pain, dizziness, headache, nausea and neck pain (Garraida 1996).

Campo and colleagues (2004) investigated the association between somatic complaints without identifiable biomedical factors, and psychiatric comorbidity in children. They found 43 % of the children to meet criteria for a depressive disorder, and 79 % meet criteria for an anxiety disorder. Among adults, somatic complaints and problems do occur with higher prevalence in lower social strata, causing suffering and reduction of life quality, and often being the main reason for sickness and disability benefits (Hetland et al. 2002; Sund & Krokstad 2005).

Communication of distress through somatic complaints, is an impaired way to express distress in children (Garralda 1996). This does not mean that the child is underdeveloped, but the immature cognitive verbal skills are limited, and normal in childhood. This can of course become a problem from a medical perspective, if the outcome leads to exaggeration or recurrent medical use.

Parental attitudes and behaviour are influencing children's psychiatric adjustment. In families with mental disorders, antisocial personalities or high levels of health problems, it is more likely that the child develop somatic complaints without any medical cause. This influence appears to be strongest associated with the mother of the child (Garralda 1996).

1.5 The use of Strengths and Difficulties Questionnaire as a screening questionnaire for child mental health

In 1997, Robert Goodman designed The Strengths and Difficulties Questionnaire (SDQ) for 4-16 years olds (Goodman 1997)(see Appendix D). It is a brief behavioural questionnaire, and consists of 25 items covering five different domains: emotional symptoms, conduct problems, hyperactivity-inattention, peer problems and pro-social behaviour, with both positive and negative behavioural traits. The items are based upon psychiatric symptoms in children of mental disorders from DSM-IV.

Four versions of the Questionnaire were designed, in order to cover the possibility of multi-information. One designed for self-report from 11-16 years old children and adolescents, a parent-report questionnaire, one for teacher-report, and one for the parents or nursery teachers of 3 and 4 year olds. SDQ can be used for screening, epidemiological research, for clinical assessment and to evaluate intervention outcomes. Since SDQ only takes five minutes to complete, and consists of both positive and negative behavioural traits, it leads to lower rates of refusal and missing answers (Goodman & Scott 1999). A screening questionnaire alone cannot predict a clinical disorder. They are usually used in the first stage of surveys, followed by clinical interviews.

In addition to SDQ, only a few questionnaires to assess a broad range of children's mental health problems exist. The Achenbach questionnaires, known as the Child Behaviour Check List (CBCL) (2000), and the Rutter questionnaires (1985), are both well-known and widely used.

To be able to better detect probable child psychiatric cases, Goodman extended the SDQ in 1999 with an impact supplement (Goodman 1999). This inclusion alters the

prevalence rate for defined high-risk cases, by only including those in need for help. This supplement asks whether the respondent thinks the person asked about has a problem, and if so, further enquires about chronicity, distress, social impairment and burden to others.

1.6 Socio-economic health inequality

Family Socio-Economic Position (SEP) is one of the social factors along with psychobiological and environmental factors that contribute to mental health differences. In the field of mental health epidemiology, the inverse relationship between SEP and the occurrence of mental disorders is one of the most well established.

The Norwegian Ministry of Health has a strong focus on socio-economic inequalities in health. They are at the beginning of a long-term dedication program to reduce these inequalities, by increasing the knowledge base of the causes (Sund & Krokstad 2005). Studies on differential effects of SEP on children's mental health have yielded inconsistent results (Canino et al. 2004; Goodman et al. 2005; Heiervang et al. 2007). This may be due to the use of different methodologies, different indicators of SEP, and varying sources of information of SEP and mental health (Bradley & Corwyn 2002). In children, mental health disorders cause a public health problems, because they are common, associated with significant impairment and form a basis for later mental disorders (Hofstra et al. 2001).

1.7 The social causation theory and the social selection theory

There is no consensus as to the causes of social inequalities in health. They are complex, and there are many competing and to a degree explainable theories as to their origins, such as the social causation theory and the social selection theory

Social causation is the hypothesis that psychological problems develop, as a result of the effect of living with adversity in those with low SEP. This has been explanatory for psychopathologies such as depression (Mollica et al. 1998), anxiety (Levav et al. 1998), and ADHD (Costello et al. 2003a) in the adult population. The causative factors are considered to be that adverse life circumstances, such as poverty, causes high levels of environmental stress. In children, this hypothesis is supported for the development of anxiety, conduct disorder (Miech et al. 1999), depression and other personality disorders (Johnson et al. 1999).

According to the *social selection* hypothesis, the causes of psychopathology are assumed not to be related to socio-economic factors, leaving genetic liabilities and the lack of

fulfilling the expected role in society to a downward socio-economic spiral (Kendler & Eaves 1986). This theory is also known as the *downward drift* hypotheses. This selection argues that the circumstances of one's social position do not have a causal connection to the onset of a mental disorder, and that low SEP is a result of individual weaknesses in mental functioning occurring first (Perry 1996). Studies have related this hypothesis in adults to schizophrenia and ADHD (Dohrenwend et al. 1992). In children, this hypothesis is associated with conduct disorder and ADHD (Johnson et al. 1999; Miech et al. 1999).

1.8 How is ADHD treated?

There is no cure for ADHD. The treatment is based on effective management of the symptoms, depending on which part of ADHD causes the problems. Usually a multimodal approach is followed, where several different treatment methods are used working together. Essentially this means: medication, family and individual counseling, or changes at school to address specialized learning styles. A combined multimodal therapy has a clinically meaningful and statistically significant advantage over mono-therapies and community treatment approaches (Conners et al. 2001). Early intervention with stimulant therapy during childhood is a strong predictor for being in work as adults, independently of comorbidity with other disorders (Halmoy et al. 2009). This implies the importance of early recognition and treatment of ADHD is a strong predictor of outcome as adult.

The consumption of ADHD stimulants in Norway has increased from 0.3, in 1996, to 6.0 defined daily doses/1000 inhabitants/day in 2008 (Rønning M. 2009). This increased use of medical treatment in ADHD may be related to changes in the definition of the disease, and regulations concerning medication treatment. The DSM-IV published in 1994, versus DSM-III, also contributed by lowering the criteria for ADHD diagnoses (American Psychiatric Association 1994), thus increasing numbers of patients diagnosed. Another possible explanation of the increased consumption of medicine, might be that before 1997, treating adults for ADHD with stimulants was illegal in Norway. As mentioned earlier, the proposed revisions of the DSM, DSM-V, may even lower the criteria additionally. This can cause an increase in the number of patients diagnosed.

1.9 The aim of this study

The intention of this study is to identify ADHD with or without co-occurring depression/anxiety in children from Akershus County, and compare whether ADHD with or without co-occurring depression/anxiety can be associated with somatic complaints. Additionally, family SEP is one of the social factors along with psychobiological and environmental factors that contribute to mental health differences, the second aim is to examine whether a low parental SEP is related to occurrence of ADHD alone, or co-occurring with depression/anxiety. The intention is to explore the possibility of socio-economic differences being related to mental health in children.

2. Methods

The method used to perform this study is described in the attached article (Leirbakk et al. in prep), but more detailed information on the method is provided in this section.

2.1 Design: The health profile

The Norwegian Health Service Research Centre undertook in 2002, a cross-sectional health survey in Akershus County, Norway. The aim of the study was to describe the health and well-being of children and youth in all the 22 municipalities in the County. Key information regarding the different aspects of both somatic and mental health would help to better plan the municipal and county health services, particularly concerning preventive measures and health promotion. Additionally, variables such as socio-demographic data, body image, nutrition, lifestyle, contact with health services, their use of drugs, social network and communication were included. To measure mental health, SDQ with impact supplement was included.

Akershus County surrounds Oslo and consists of 22 municipalities. It covers both urban, suburban and rural areas, with inland and coastline, and clear socio-economic difference. From third grade primary school (8-9 years) to the last year of high school (18-19 years), pupils were invited to participate in the health profile study. In grade 3 to 7, the parents were also invited, and asked to fill out a questionnaire regarding their child. Each municipality in the County was invited with a minimum of 1000 pupils. The classes were randomly selected to give a representative sample of the County as a whole. The pupils received an information letter about the intention of the survey, and that it was anonymous and voluntary to respond. At each school, the principal was responsible for arranging the questionnaire to be filled out at the same day, and exact same hour to avoid the possibility for the pupils to talk about their responses beforehand. He was also responsible for informing the teachers about the intention and implementation of the survey. In each class, the teacher explained to the pupils how to fill out the questionnaire correctly, and how to seal it in an envelope before handing it in. The pupils completed the questionnaire at school under supervision of a teacher, and the parents completed theirs at home, in this way the parents and children could not confer.

In order not to violate the anonymity of the participants, each questionnaire was given a reference number, making it possible in retrospect to link parents to their children.

2.2 Participants

2.2.1 Self-report

43,248 pupils from third grade in primary school to last year in high school were invited to participate in the health profile. A total of 36,456 (84,3 %) pupils responded.

From fifth grade the SDQ was included in the health profile questionnaire, and adolescents between 16-19 years of age were also asked to complete the SDQ self-report. SDQ self-report is not advised to be used on children under the age of 11, it is designed for children between the age of 11 and 16 years, therefore not included in the questionnaire of the youngest pupils.

2.2.2 Parent's report

A total of 14,698 (78 %) parents participated in the Akershus health profile. Parents with children in grades 3-5, participated with a response of 6,164, and 8,534 parents with children in grades 5-7 took part in the survey.

Of these 14,698 parents, a total of 12,900 (87,8 %) completed the SDQ. The response from parents with children in grades 3-5 were 5,302, and 7,598 parents with children in grades 5-7, completed the SDQ.

2.3 Measures

2.3.1 Measurement of ADHD

High risk cases were defined by using SDQ and the impact supplement (Leirbakk et al. in prep). Symptoms used in SDQ, versus symptoms from DSM-IV, are not all available. The 5-item long SDQ hyperactivity-inattention subscale is a shorter substitute for the 18-item ADHD symptom list in DSM-IV (see appendix III). In the SDQ hyperactivity-inattention subscale, two out of five items are on attention, two are on hyperactivity, and the last one is on impulsiveness. Two items are positively worded. It was constructed in this way because these are the three key symptom domains for a DSM-IV diagnosis of ADHD (American Psychiatric Association 1994).

2.3.2 Measurement of depression/anxiety

High risk cases were also defined by the using SDQ and the impact supplement (Leirbakk et al. in prep). Symptoms used in the SDQ emotional subscale, consists of symptoms regarding

any depressive disorder and any anxiety disorder in general. Two items on anxiety, two items on depression, and one item regarding both disorders together form the emotional subscale.

2.3.3 Can SDQ identify possible cases in this study?

In accordance with suggestions by Goodman and colleagues, and Vikan (Goodman et al. 2000; Vikan 1985), who demonstrated highest sensitivity in predicting any type of psychiatric disorder in children by parent-report, this study is based upon parent-report.

2.3.4 Norwegian cut-offs

Goodman designed the cut-off points based on the overall prevalence for mental disorders among children and adolescents found in the UK in 1999 of 10 % (Ford et al. 2003). The upper 10 % is therefore by SDQ considered a high-risk group, next 10 % defined as borderline, and remaining group characterized as low risk for any mental disorder. This threshold for characterization of high-risk, borderline and low-risk is used when implementing Norwegian cut-offs, and are supported by findings of same upper 10 % prevalence in a Norwegian study, as in the UK study from 1999 (Novik 1999). But in order to imply the threshold of a 10 % high-risk group in a Norwegian population, the cut-offs needed to be adjusted. This resulted lower cut-offs for the Norwegian population. It is therefore necessary to define the threshold in each study, where SDQ is used, in order to categorize the sample into “high-risk”, “borderline”, and “low-risk”.

For “The Akershus Health Profile”, Betty Van Roy defined the cut-offs based on these suggestions (Van Roy et al. 2006), and these are the thresholds used in this study (Leirbakk et al. in prep).

2.3.5 Measurement of somatic complaints

The definition of somatic complaints included headache, abdominal pain or neck pain, with a persistency of almost every week or more, during the last six months (Leirbakk et al. in prep).

2.3.6 Measurement of socio-economic position

Parents’ household income and highest completed maternal and paternal education was used to define the SEP of the family (Leirbakk et al. in prep). Income for low SEP was defined by one average Norwegian salary in 2002 (Hansen & Skoglund 2003). In 2002, this salary was 320 000 Norwegian kroner (NOK). In order to be sure to include all families with one average salary, the limit was set at 400 000 NOK for low SEP. Categorized answers for income in the

cross-sectional health survey was: “under 200 000 NOK”, “200 000-300 000 NOK”, “400 000-600 000 NOK”, “600 000-800 000 NOK”, “800 000-1000 000 NOK”, and “over 1000 000 NOK”.

The group was dichotomized into low SEP and average/high SEP, in order to identify the degree of adverse health outcome in the low SEP group, compared to the group with average/high SEP.

2.3.7 Additional measures

To further investigate the correlation between ADHD and/or depression/anxiety and SEP, we included income, maternal education and paternal education as independent variables in a logistic regression with the disorders. Paternal education and maternal education were dichotomized in the same way as in SEP, meaning that low education is less than university, and high education is education at university level. Household income was also dichotomized according to the same procedure as in SEP. Average/high income was defined as income over 400 000 NOK, and low income was income under 400 000 NOK.

Since a possible bias can be single parent, this factor was adjusted for. The variable of single parent was assessed by combining two outcomes of the question “With whom does the child live?”. Possible responses being: “both mother and father”, “mother and stepfather”, “father and stepmother”, “every other week at mother and father”, “only with mother”, “only with father”, “the child lives with one of the parents every other weekend and one day a week”. The two responses “only with mother” and “only with father”, were combined. Positive responses to either of the two, were interpreted as single parent. This created a dichotomous variable where any other responses were characterized as “not single parent”, and “only with mother” and “only with father” accounted for positive to single parent.

2.4 Statistical analyses

The Statistical Package for the Social Sciences (SPSS) v17.0 software package, was used for all statistical analyses in this study (Leirbakk et al. in prep). Missing data was excluded casewise, meaning that the cases were excluded if they were missing on the data required for the specific analyse.

To perform the additional measures not presented in the article (Leirbakk et al. in prep), a logistic regression was used to investigate the correlation between ADHD and/or

depression/anxiety, and household income and education level of the parents. In this regression the factors adjusted for included single parent, as well as gender and school grade.

Associations between ADHD and/or depression/anxiety and family income and parental education, were explored using bivariate logistic regression with calculation of Odds Ratio (OR) and Confidence Intervals (CI). 95% confidence interval was used, it covers 95% of the normal curve, and makes the probability of observing a value outside of this area less than 5 % (Nunnally & Bernstein 1994). Variables were adjusted for age, school grade and single parent. The choice to use Spearman's rho (r) to explore correlations of the statistical dependence between the independent variables, was founded on the fact that the variables were non-parametric.

The result presented in Table 1 demonstrates a low to moderate correlation between the independent variables (gender, grade, somatic complaints, income and parental education). Threshold for weak, moderate and strong correlation according to Cohen (1988), is set at: $r \leq 0.1$, $r \leq 0.3$, and $r \geq 0.5$. Strongest correlation was found between single parent and family income ($r=0.484^{**}$).

Cronbach's alpha was used on the subscales from SDQ to explore the internal reliability. Cronbach's alpha on the hyperactivity-inattention scale, after reversed score on positive items was 0.76, for the emotional scale it was 0.66, and for the impact scale 0.82. We also compared the hyperactivity-inattention scale and the emotional scale by including them in the same analysis, resulting in a Cronbach's alpha of 0.75. A commonly accepted rule for describing internal consistency using Cronbach's alpha is: ≥ 0.9 = excellent, $0.9 > \geq 0.8$ =good, $0.8 > \geq 0.7$ = acceptable, $0.7 > \geq 0.6$ =questionable, $0.6 > \geq 0.5$ =poor, $0.5 > =$ unacceptable (Nunnally & Bernstein 1994).

Table 1: Edited correlation matrix of independent variables by using Spearman's rho.

	Gender	Primary school grade	Paternal education	Maternal education	Family income	Single parent
Primary school grade	0.012					
Paternal education	0.010	0.011				
Maternal education	-0.011	0.030**	0.475**			
Family income	0.005	-0.004	0.245**	0.208**		
Single parent	-0.006	0.023**	0.077**	0.046**	0.484**	
Somatic complaints	0.061**	0.047**	0.048**	0.046**	0.069**	0.048**

*=p<0.05, **=p<0.01

2.5 Ethics

Parents were informed by the local school at least one week prior to the implementation, and asked to give their written consent. All participation in the study was voluntary, and no directly identifiable personal data was collected. After completing the questionnaire, they were sent with the child to the school in a sealed envelope, and delivered to the teacher. After receiving all the questionnaires, they were delivered to a contact person for the municipality and from there picked up by the research responsible. Data is stored at Norwegian Institute of Public Health, and not available elsewhere. Approval from the Regional Committee for Medical Research Ethics (REC) was given in advance for the Akershus health profile (see Appendix C).

3. Results

The results from the present study is reported in our article “ADHD with co-occurring depression/anxiety in children: the relationship with somatic complaints and parental socio-economic position”, (in prep). Only a brief summary of the results are presented here. In addition some supplementary results will be presented.

3.1 Summary of “ADHD with co-occurring depression/anxiety in children: the relationship with somatic complaints and parental socio-economic position”

This study defined 1.3 % of the children in Akershus between 8-13 years as having ADHD alone, 2.9 % of the children to have depression/anxiety alone, and 1.8 % to have co-current comorbidity of the disorders. The estimate for boys exceeded that for girls, with significant gender differences for children with ADHD alone, as well as for the group with both ADHD and depression/anxiety.

Totally, 58 % of the children with ADHD were comorbid with depression/anxiety. Children with ADHD alone were not associated with somatic complaints. But children with ADHD and comorbid depression/anxiety, showed significant associations with somatic complaints. As in the adult population, there is an inverse relationship between the prevalence of ADHD and/or depression/anxiety in children, and parental SEP. These findings imply a higher prevalence of ADHD alone, depression/anxiety alone, and comorbidity of both disorders when the parents are in a low SEP.

Analysis of the prevalence of children with ADHD and/or depression/anxiety was also done before including the impact section in SDQ. Before the impact supplement was considered, the percent of high-risk of ADHD cases was 11.5 %, and 10.1 % of the children were classified as high-risk of depression/anxiety.

3.2 Additional results

Table 2 presents the association between the occurrence of ADHD, depression/anxiety and comorbidity, and paternal education, maternal education and family income. Neither ADHD and/or depression/anxiety were associated to low maternal education. However, all three groups were significantly associated with low paternal education, strongest association for the group of children comorbid with ADHD and depression/anxiety (OR=1.865***). Children

with depression/anxiety alone had twice as high risk to come from a low income family, meaning income under 400 000 NOK, compared to the control group of children negative to ADHD or depression/anxiety. Children with both ADHD and depression/anxiety, was also associated with low income in the family (OR=1.678**). The results were adjusted for gender, primary school grade and single parent.

Table 2: Logistic regression analysis examining the association between ADHD alone, depression/anxiety alone or comorbidity of the two, and the association of paternal and maternal education and family income.

		ADHD OR (95 % CI)	Depression/anxiety OR (95 % CI)	Comorbidity OR (95 % CI)
Paternal education	High	1.	1.	1.
	Low	1.619 (1.084-2.417)*	1.449 (1.107-1.897)**	1.865 (1.294-2.688)***
Maternal education	High	1.	1.	1.
	Low	1.360 (0.916-2.019)	1.026 (0.790-1.331)	1.336 (0.941-1.896)
Family income	>400 000	1.	1.	1.
	<400 000	1.219 (0.816-1.829)	2.096 (1.625-2.705)***	1.678 (1.202-2.343)**

OR=Odds Ratio, CI=Confidence interval. Adjusted for gender, primary school grade and single parent. Reference category is: Control-negative to ADHD or depression/anxiety

*p<.05. **p<.01. ***p<.001.

4. Discussion

In this section the methodological considerations of the study will be discussed first, followed by a discussion of the results in the study.

A brief discussion regarding the prevalence of ADHD and/or depression/anxiety, and the results from our study, is also presented in the article (Leirbakk et al. in prep).

4.1 Methodological considerations

4.1.1 The Akershus health profile

One of the assignments for the Norwegian Ministry of Health is to reduce health inequalities, by increasing the knowledge base of the causes (Sund & Krokstad 2005). In order to do this it is necessary to survey the effects of treatment and prevention on the impact, burden and prevalence of mental health and disorders in children. One way to do this is by performing surveys, such as the cross-sectional health profile this study is based upon. It is of importance to notice that the application of SDQ in the survey, was not motivated in order to define prevalence of psychiatric disorders, but rather as a routine screening for the county to recognize possible problem areas. Since the design was cross-sectional, conclusions about causality cannot be addressed. However, the design can provide knowledge about associations, which is useful for public health planning, understanding disease aetiology, and for the generation of hypotheses (Bland 2001).

The major advantage of this survey was the high response rate from both self-reports and parent-report, from a large sample size, which was randomly selected from a representative area of Norway, each municipality with at least 1000 pupils invited. Akershus County is representative for the Country as whole in terms of urban, suburban and rural areas, with inland and coastline, and a clear socio-economic difference. This makes it possible to generalize our findings to the population, also known as population validity that represents a type of external validity. According to Cook and Campbell (1979) external validity is the approximate validity with which we can presume that our findings of a inferred causal relationship can be generalized to and across alternate measurements of the cause and effect. This also includes different types of time, persons and settings.

In terms of ecological validity, which is the type of external validity that looks at the settings to see how much they influence the behaviour, the results in this study are also likely to generalize (Shadish et al. 2002). This is because the children conducted the questionnaire

during regular school hours in class, with their teacher as supervisor, resembling a normal school situation. Parents did this at home, in their own familiar environment, without supervision.

In terms of internal validity, we cannot place any confidence in the cause and effect relationship in this study, due to the cross-sectional design. Internal validity is the approximate validity of the possibility to assume a relationship between the variables exist and are causal, and absence of relationship indicates absence of cause (Cook & Campbell 1979). On the other hand, we can identify a link between two variables of interest, by eliminating potential confounding variables. For instance, we did find an inverse relationship between low SEP and prevalence of both ADHD and/or depression/anxiety, by controlling for gender and primary school grade. When we broke down the variables used to define SEP into paternal education, maternal education and income, and controlled for gender, primary school grade and single parent, the association to which factor was strongest became clearer (see Table 2). Still we cannot be certain that one variable causes the other, or which variable came first, but we can identify the relationship, and state a need of further research of the causes. In this example there are developed theories and hypotheses describing possible relationship between SEP and ADHD, such as the social causation hypotheses and the social selection hypotheses, which we will discuss later.

It is important to mention that questions from the Akershus health profile, used in our study, has not been officially translated into English. This translation has been made by the authors of the article (Leirbakk et al. in prep). It is a possibility that cultural differences of meaning in the various concepts, have been missed in our translation. Any misinterpretations due to translation, the responsibility is entirely our.

Only SDQ, which originally is in English, is presented in the Akershus health profile in an official Norwegian translation. The version in Appendix D, is the original version, made by Goodman (see Appendix D).

4.1.2 The use of parent-report

We made a choice to only use parent report, a choice founded on the fact that SDQ was implemented in the child-report from 5th grade. Any multi-informant association would therefore only regard children from 5th to 7th grade, and we would miss the opportunity to explore ADHD and/or depression/anxiety regarding children grade 3-7. This poses a limitation on the prevalence of ADHD and depression/anxiety, and Goodman and colleagues (2004) advise using multi-informant information when it is possible. Self-report works best at

detecting emotional disorders, but misses the majority of hyperactivity-inattention problems. The prediction works best overall, when SDQ has been completed by both parents and teachers (Goodman et al. 2004). However, the teacher-report was not included in the survey

Not all parents completed the SDQ. It might be that the parents who chose not to complete, in fact themselves, or the child, were positive cases of ADHD or depression/anxiety, and would have made a useful asset to the survey and this study. Their lack of motivation or willingness to participate is a concern, and a possible selection bias. It is of importance that we do not forget that most of the missing cases were mainly caused by children not being at school the day that the questionnaires were handed out, implicit their parents were neither given their questionnaires. Since we have no information of the non-responding parent, it was not possible for us to control for who they were in the study. It was neither possible to explore the socio-economic situation for the non-responding parent or family, since the variables of interest only were included in the parent-report. In that sense, we cannot characterize the missing parents by using the self-report of the children, in those cases where only the child responded.

It would have been interesting to know the degree of mental problems for the group of non-responding parents and children, and if they had been categorized as high-risk according to SDQ. We could have characterized the group of children, where parent response was missing. If this had been done, the outcome would only regard children grade 5-7 where SDQ was included. And as mentioned, children provide poor information on hyperactivity-inattention problems. Especially boys with ADHD, overestimate their self-perceptions in the scholastic, social and behavioural domains (Hoza et al. 2002), mainly in order to protect their positive self-image (Ohan & Johnston 2002).

4.1.3 SDQ as measure of ADHD and depression/anxiety

SDQ is proved to work at least as well as CBCL (Goodman & Scott 1999; Novik 1999) and Rutter questionnaires (Elander & Rutter 1996), correlating highly with both. In a study by Goodman and Scott (1999), SDQ was significantly better at detecting inattention and hyperactivity problems compared to CBCL, and at least as good at detecting internalizing problems such as depression and anxiety. This way of comparing the SDQ with an established method, such as CBCL and Rutter questionnaires, is known as criterion validity. This refers to a type of construct validity, where construct refers to a theorized psychological construct. Construct validity refers to whether a scale or test measures the construct adequately (Campbell & Stanley 1966). The high correlation between both methods and SDQ, signifies a

high construct validity.

Reliability is concerned with the replicability of scientific findings. Internal consistency is one type of reliability, and defines the consistency of the results in a test (Cook & Campbell 1979). In order to discuss the internal consistency of SDQ, it is necessary to present the Cronbach's alfa coefficients for the three different subscales used. Cronbach's alfa indicates the degree to which a set of items measures a single unidimensional latent construct (Campbell & Stanley 1966). The hyperactivity-inattention scale, had a Cronbach's alfa of 0.76, which is acceptable (Nunnally & Bernstein, 1994). For the impact scale, the internal consistency was good with Cronbach's alfa of 0.82, and lowest for the emotional scale, with Cronbach's alfa of 0.66. The result of a low Cronbach's alfa on the emotional scale, may be due to the use of parent-report. Studies where self-report is used, has proved to work better at detecting emotional problems than parent-report (Goodman et al. 2004). However, our results compared to other studies, where the same method has been used to measure high risk groups, provides support for our findings. In fact, our results indicate an equal or higher internal consistency (Goodman 2001; Rønning et al. 2004; Rønning M. 2009; Van Roy et al. 2008). When comparing the hyperactivity-inattention subscale with the emotional subscale by including all ten items in the same analysis, the Cronbach's alfa was 0.75, which implies a high correlation. On account of the high rate of comorbidity between ADHD and depression/anxiety (58 %), this degree of correlation is not as surprisingly as one might assume. It indicates just as well a relationship between the disorders, as it does contrast the internal consistency of SDQ.

The inclusion of positively worded items is both clinically, as well as theoretically motivated, and one of the strengths of the SDQ. It is important to include protective factors and positive behaviours to obtain a clinically, broad and meaningful psychopathological profile (Rothenberger & Woerner 2004). If we had removed the positively worded items, it might have resulted in a decreased acceptability and a lower willingness to complete the questionnaire, and is therefore not recommended (Rønning et al. 2004).

We did not re-test our stability of the SDQ. Nevertheless, this has been done by Goodman in a study from 1999, with a stability of parent report from 0.44 to 0.85, with a mean of 0.63, and the change in mean from -0.04 to -0.30, yielding satisfactory internal consistency (Goodman 1999). This proves that SDQ is highly reliable as an instrument that comprises psychometric properties. However, it is not possible to estimate the stability of our results, as we did not re-test our results.

4.1.4 SDQ as a clinically relevant measure of ADHD and depression/anxiety

Defined cases of ADHD and/or depression/anxiety were lacking clinical validity, requiring most results to be interpreted with caution. However, significant correlations reported in this survey do identify high risk groups. This group is important to identify in order to early intervene and possibly prevent from developing severe burden and adverse long-term outcomes.

The use of both symptoms and impact strengthens a possible presence of a psychiatric disorder, because symptoms alone are not precise enough to predict the presence, or absence, of a psychiatric disorder (American Psychiatric Association 1994; Goodman 1999). The estimated prevalence in this study before including impact, was for ADHD 11.5 %, and for depression/anxiety 10.1 % of children, a result that is not representative for the Norwegian, or global population. The prevalence of ADHD and/or depression/anxiety after inclusion of impact in our study, is in agreement with both Norwegian and globally estimated prevalence of 3 to 5 % (American Psychiatric Association 1994; Canino et al. 2004; Costello et al. 2003b). SDQ is also based upon the criteria of the disorders in DSM-IV, and is therefore a strong support for content validity. Content validity, also called logical or rational validity, is the estimate of how much every single element of a measure is a representable way to measure the construct (Cook & Campbell 1979). By implementing SDQ in the health profile, none of the respondents were aware that SDQ can be used to predict possible cases of mental disorders. They could have answered differently, if they had been aware of the possibilities of SDQ. This may be interpreted both as positive and negative, in regard of the outcome.

By lacking clinical validation, it was not possible to define the sensitivity and specificity of the SDQ results, or determine clinical cases. As mentioned in our article (Leirbakk et al. in prep), it might be a concern to only include clinically confirmed diagnoses of children with disorders, based on the assumption that families of low SEP pay fewer visits and have less access to the doctor (Sacker et al. 2000). It is therefore possible that we would miss some disorder positive cases if we only allowed those who were clinically diagnosed in our study, and there is a substantial delay before symptomatic children access specialist services (Sayal 2004). Knowing that the onset of both ADHD and depression/anxiety symptoms in childhood may differ, it is possible that our way to define positive cases captures some children that have not yet been diagnosed, but are disorder positive. Critically, this way to define the positive cases might just as well capture negative cases, wrongly assuming them to be positive.

We made a choice to only define cases based on the high-risk group, and excluded

those who were borderline. It is of importance to note that by doing so, we might have missed some positive cases of the disorders. SDQ does not fulfil all symptoms of ADHD and depression/anxiety that is mentioned in DSM-IV. Some of the children classified as borderline or even low risk, can be positive cases according to other symptoms that are missing in SDQ. SDQ classifies the children in the borderline group as at risk of ADHD and/or depression/anxiety, but do not fulfil the criteria as well as those in the high-risk group. By including borderline in the group of defined cases, the rate of false positives would have accelerated, and given us a false elevated prevalence, not in accordance with Norwegian or globally expected values.

ADHD, when mentioned in this study, is the combined type of ADHD, known as ADHD-C, according to DSM-IV. The choice not to define possible cases of ADHD-PI or ADHD-PH was based on the weak sensitivity of the hyperactivity/inattention subscale in SDQ to define the two subtypes of ADHD (Ullebø et al. 2011). In a study by Ullebø and colleagues (2011), both ADHD-PI and ADHD-PH, when measured by SDQ, had a high rate of false negatives and failed to identify many children with significant symptoms of the two subtypes. However, using SDQ to define positive ADHD cases, do not include all symptoms in DSM-IV, and do not separate between the three possible diagnoses of ADHD, thus some identified children may be ADHD-PI, and some ADHD-PH. Not all cases are clearly ADHD-C, in this study referred to as ADHD.

Our defined group of depression/anxiety, consists of several possible disorders: separation anxiety disorder, generalized anxiety disorder, social anxiety disorder (social phobia), panic disorder, panic disorder with agoraphobia, obsessive compulsive disorder, specific phobia, major depressive disorder, and dysthymia. All of these disorders are subtypes of depression or anxiety. As a group, they are characterized by being disorders that are internalizing and emotional. The decision not to separate between the disorders, and only refer to the group as “depression/anxiety”, was the desire to explore the comorbidity between ADHD and the entire group of children with depression and/or anxiety disorders. To be able to separate between the different types of disorders, it would have necessitated having a clinical valid diagnosed group, and as mentioned, this was a drawback of this study.

The resemblance between somatic complaints, and the SDQ question on headache, abdominal pain or nausea to define depression/anxiety, promotes the issue of interrelationship. In order to account for this relationship, we used Spearman’s rho, which is a non-parametric measure of the strength and direction of association between two variables on an ordinal scale (Pallant 2007). Correlation between the item: “Often complains of headaches,

stomach-aches or sickness” and the variable “somatic complaints”, was 0.4. Low correlation, and a desire and possibility to explore the frequency of complaints, obtained a support to proceed.

4.2 The prevalence of ADHD and comorbidity

In this study, 3.1 % of the children were defined as high-risk of having ADHD. This prevalence was determined by using SDQ, both symptoms and impact, and cut-offs based upon a 10 % high-risk group. Global and Norwegian prevalence is estimated to be 3 to 5 %, according to the DSM-IV, and correlates well with our findings (American Psychiatric Association 1994).

The frequency of occurrence of ADHD is in dispute, and studies reports prevalence varying from 1.7 % (Heiervang et al. 2007) to 16 % (Barbaresi et al. 2002). If we had defined the disorders solely in terms of psychiatric symptoms, the result would have been implausibly higher prevalence rates. Before including the impact section, the prevalence of ADHD in our study was 11.5 %, which implies a high rate of children fitting the symptomatic picture of ADHD.

In an epidemiological study by Bird and colleagues, they estimated the prevalence of Puerto Rican children to meet criteria for at least one DSM-III diagnosis to be 49.5 % (Bird et al. 1988). This was done without acknowledging the importance of impact, when screening for a possible disorder. By exclusively focusing on symptoms, one ignores factors, such as burden and impact, that have an important aspect, and affects the probability that the child would be taken to mental health services for examination (Goodman 1999). When taking into account the chronicity and burden of the problems, the prevalence of high-risk cases decreases, and gives a more accurate detection of the children in need of treatment.

Simonoff and colleagues (Simonoff et al. 1997) did show in their twin study, how the prevalence fell from 41.8 % children meeting the diagnostic criteria for at least one psychiatric disorder, to 11.4 % when social impairment was considered. Both DSM-IV (1994) and the World Health Organization (1996), agrees that a psychiatric diagnosis cannot be made without the presence of substantial distress, or social impairment. To ratify impairment, parent rating has proven to be valid (Bird et al. 1996). Both in survey studies and explicitly designed studies, the SDQ impact scale has received limited attention (Vostanis 2006). Whether this is related to pragmatic reasons, or a wish to focus on symptomatic outcomes rather than subsequent impairment, remains unanswered.

In our study, the likelihood for being a boy and having ADHD alone, was over five times as high, compared to being a girl and having ADHD alone. The result slightly exceeded the predicted one, according to DSM-IV (American Psychiatric Association 1994) and other studies (Graetz et al. 2005; Heiervang et al. 2007), where the odds ratio was between 2.8 and 4.0 for boys with ADHD. The risk for being a boy and having both ADHD and depression/anxiety, was 2.4 times as high as for girls in our study. Overall, this indicates that the possibility for being a boy and having ADHD, with or without depression/anxiety, is between 2.4 and 5.4, which is also in accordance with DSM-IV, saying boys are four times more frequently diagnosed with ADHD, compared to girls (DSM-IV).

As explained in the introduction, the heterogeneity of ADHD is a challenge. The high rate of associated problems and co-occurrence of comorbidity, due to underlying ADHD, requires special attention and knowledge when the disorder is interpreted and diagnosed. In agreement with other studies, we found comorbidity between ADHD and depression/anxiety, to apply for 58 % of the children with ADHD (Costello et al. 2003b; Fleitlich-Bilyk & Goodman 2004). Such pattern is necessary to identify, in order to provide basic epidemiological data of comorbidity, regardless of referral bias and local practice.

ADHD as a “pure” disorder is rare, and the number of children with ADHD and an additional disorder, by far outnumbers those with ADHD alone (Kadesjo & Gillberg 2001). Children with ADHD and an additional disorder are in need of great attention and treatment. In a controlled longitudinal study by Rasmussen and Gillberg (2000), these children had exceptionally poor long-term outcome with high rates of alcohol and drug abuse, antisocial personality disorder, and low rates of independence at age 22. The most important conclusion we can draw on the basis of the present results, is that ADHD is associated with depression or anxiety in a vast majority of all cases. When a study does not screen for possibly comorbidity in children with ADHD, there is a risk of wrongly drawing conclusions, by relating them to either the aetiology of ADHD or a symptomatic outcome. This may result in a bias that can cause unnecessary suffering, and a lower or less effective treatment.

4.3 ADHD and depression/anxiety as expressed by somatic complaints

In our study, when somatic complaints was divided into the different types of complaints and compared to ADHD, neither headache, neck pain, nor abdominal pain, had any associations with ADHD alone. However, a child with both ADHD and depression/anxiety, expressed significant symptoms of somatic complaints, and each complaint on its own, was also

significantly associated. In a study by Holmberg and Hjern (2006), they found support for significant somatic complaints in children with ADHD. Complaints were measured by recurrent abdominal pain, headache, sleeping problems and day tiredness, and only headache did not have any association with ADHD. However, their study, did not clarify whether or not the children with ADHD and somatic complaints, possibly had co-current depression or anxiety. They only screened for ADHD, a disorder known for comorbidity of one or more disorders.

The association between ADHD and abdominal pain was also significant in a study by Egger and colleagues (1999), with the same deficiency as in the study by Holmberg and Hjern. They did not control for possible comorbidity situation in the children with ADHD. Taken into account that somatic complaints are a symptom of depression and anxiety, the results of both studies are questionable. Our findings, suggests that a child with ADHD, that expresses somatic complaints, is likely to be co-current comorbid with depression or anxiety, and that somatic complaints do not occur as a result of ADHD alone.

But, as discussed in our article (Leirbakk et al. in prep), there cannot be made any causal relationship based on a cross-sectional study, nor can it be assumed that the children did not have somatic symptoms with a medically explainable cause. In this study, we found no association between ADHD alone and somatic complaints, which indicates that children with ADHD alone do not have significantly more somatic complaints, compared to children without ADHD or depression/anxiety.

Knowing the long-term outcome of ADHD, and the fact that most children with ADHD have a history of symptoms for several years before they are diagnosed, it is important for acknowledge the pathogenesis of ADHD, and that a comorbid situation is the case more often than the exception. If the symptomatic history of a child with ADHD, also are in agreement with a diagnosis of depression or anxiety, it is of importance to consider a comorbid situation. Somatic complaints are, according to DSM-IV, not a symptom of ADHD, but rather a symptom of an emotional disorder (American Psychiatric Association 1994). In a review by Mackenbach (1992), he found an inverse association between low socio-economic position and the prevalence of somatic complaints in adults. This hypothesis has been confirmed to also apply for children (Groholt et al. 2003). In a way, these findings add strength to our results. Children with ADHD and depression/anxiety did have severe somatic complaints, and more often came from families of low SEP, compared to families of average/high SEP.

4.4 The relationship with parental socio-economic position

We found an inverse relationship between low SEP and prevalence of ADHD and/or depression/anxiety (Leirbakk et al. in prep). In a cross-sectional study by Amone-P'Olak and colleagues (2009) on SEP and mental health problems among children, they found a strong association for externalizing problems (aggression and delinquency) and low SEP, and when externalizing problems were comorbid with internalizing problems (depressed/anxious and depressed/withdrawn).

When the variable of SEP was tested against the different components individually, paternal education, maternal education and income, we found a strong support for low paternal education and higher prevalence of ADHD alone, depression/anxiety alone and the group with comorbidity of ADHD and depression/anxiety. There was no association with low maternal education in our study. To some degree, this is in accordance with the Norwegian study by Duric and Elgen (2011), where they found significant associations between the prevalence of ADHD and both low paternal and low maternal education, slightly higher association with low paternal education. Low income was in our study, associated with the group with comorbidity of ADHD and depression/anxiety, and depression/anxiety alone, but not ADHD alone. It is important to note that both education and income were included in the logistic regression adjusted for single parent, as well as gender and school grade. In the article of this study (Leirbakk et al. in prep), when SEP was used, single parent was not controlled for. It could have presented a possible bias. To test the importance of this, single parent was adjusted for in Table 2, however it did not weaken the results presented in the article of this study.

The variable of SEP, that was constructed, demonstrated strong support for an inverse relationship between SEP, ADHD alone, depression/anxiety alone and the group with comorbidity of ADHD and depression/anxiety (Leirbakk et al. in prep). These findings are in accordance with a report by Blas and Kurup for the World Health Organization (WHO) (2010), where they found very convincing support for the role of SEP and mental health in children. The role of education and mental health was strongly supported, and there was reasonable evidence regarding income inequality as health determinants. When they combined income and education, the support was more convincing, compared to income and education measured as single factors.

SEP may be related to several mechanisms, besides parental education and income, such as inequalities in access to goods and services essential to health, as well as different

parental health promoting behaviour (Bradley & Corwyn 2002). Families with low SEP often live in houses in deprived neighbourhoods, with a high rate of social problems such as drug abuse and crime (Schneiders et al. 2003). Such families also experience more distress, which impacts the relationship between parents and their children. Moreover, poverty may also cause poor family functioning, child abuse and poor fostering behaviour (Schneiders et al. 2003). But, as mentioned in the introduction, there is no agreement on the causes of social inequalities in mental health. The relationship is complex, with many competing, and to a degree explainable hypothesis, such as the social causation hypotheses and the social selection hypothesis.

4.5 What comes first: low socio-economic position, or mental health problems?

The role of economic and associated socio-structural factors are according to the social causation hypothesis emphasised. Belonging to a low SEP is associated with mental health implications. Families in low SEP may be relatively disadvantaged in relation to the risks of illness or accident, or to the factors that promote a healthy lifestyle (Wadsworth & Achenbach 2005). They also experience a higher degree of not fulfilling the expected role in society, which causes depression, anxiety, violence, substance abuse, and low self-esteem (Blas & Kurup 2010). Children growing up in families experiencing such stressful life events, are likely to adapt to their parent's behaviour, called learned behaviour. These children are also more likely to have greater conflict and fewer positive communications with family (Hart & Risley 1995; McLoyd 1998), and less warmth in parental relationships (Dodge et al. 1994).

Longitudinal studies of children's problems do provide a purer test of social causation effects than is possible to do with adults. In a longitudinal study it would be possible to track the outcome of children's problems and consultations with mental health services, and relate it to their parents' SEP. By tracking down the outcome of children's problems, it is possible to identify effects predicted by the social causation hypothesis, separately from the social selection hypothesis that may result from adult psychopathology (Wadsworth & Achenbach 2005).

The social selection hypothesis failed to refute the likelihood that individuals in low SEP are at greater risk of developing a mental disorder, compared to individuals with a moderate to abundant economic resource (Perry 1996). According to this hypothesis, individuals in the highest social position are made up of the strongest, and most robust, men, women and children in the population. The lowest social position, on the other hand, consists

of the weakest people. The idea is that poor mental health causes low social worth, and low economic reward, rather than that these two factors are the cause of mental health problems (Murali & Oyebode 2004). But, the way a child behaves does not determine the SEP of a family.

Both hypotheses emphasize the role of genetic vulnerability. Research does confirm the role played by genetic vulnerability of individual's in a wide range of mental disorders (Costello et al. 2003a; Johnson et al. 1999; Perry 1996). According to the social selection hypothesis, the gene-environment correlation in affected individuals and often their family members, cause them to enter a downward drift in SEP. By being in a low SEP, the environments themselves often provide an increased risk for mental illness. The social causation hypothesis, also reflects the gene-environment interaction. According to this hypothesis, individuals with genetic vulnerability remain latent, unless they are exposed to environments that are economically adversely related, or associated with socio-structural factors.

The causal relationship in our study is unachievable to ascertain, based on the cross-sectional design of the study. Nor can it be argued which hypothesis best fit our findings. The inverse relationship of low SEP associated with higher prevalence of ADHD and/or depression/anxiety, is documented, and is possible to be generalized to exist among children in Norway. Further than that, it is not possible to draw any conclusions.

It is realizable that genetic effects are more present in low SEP. This indicates for instance, that parents in a low SEP with ADHD and/or depression/anxiety, represents the majority of the prevalence of the disorders. Therefore, it is more likely that their children may develop one, or both, of the disorders based on genetic vulnerability, and associated socio-structural factors of being in a family of low SEP, to a higher degree than children with ADHD and/or depression/anxiety and parents in a high SEP. This indicates that those who are genetically most vulnerable, are also most susceptible to psychiatric adverse effects of an unfavourable environment (Mathiesen et al. 2009). This possibility does not contradict the social causation hypothesis, as genetic hereditary predispositions may be aggravated by social adversity.

Genetic vulnerability or differential susceptibility, implies that there are more negative outcomes for susceptible children in unfavourable environments, but also more positive outcomes for susceptible children in favourable environments (Bakermans-Kranenburg & Van Ijzendoorn 2007).

4.6 Prevent and intervene

As we have seen, there are complex reasons for the development of mental health problems in the children, in this study defined by ADHD and/or depression/anxiety. Two overall suggestions as to prevent and intervene will be presented. Primarily the presentation presents preventive strategies aimed at reducing mental health problems in children.

4.6.1 Monitoring at municipality level

There should be created an interdisciplinary collaboration with intention to identify symptoms of mental health problems in children. This includes an awareness, competence, and basic knowledge both at school level, kindergarten and at health station, in order to intervene before the problems accelerates (Norvoll et al. 2006). Surveys, such as the Akershus health profile, can be used to provide key information to aid a preventive strategy, and to better identify problem areas for the municipality to set in intervention methods.

In Norway, all new born children are visited by a public health service nurse in one of the first weeks after they are born. This arrangement is possible to expand to include all pre-school children, as a way to support families, prevent marginalization and invisibility of high-risk families and children with special needs. The public health service nurse can provide health information, offer support, and identify any need for help or detect symptoms of mental health problems.

4.6.2 Focus on the environment

Both the social causation hypothesis and the social selection hypothesis do acknowledge, that the environments of the child are of great importance regarding a possible development of a mental disorder. Children need to be an integrated part of a social community with both adults and other children (Baumeister & Leary 1995). They need to be seen and appreciated, and able to explore in environments that are understandable to them, and where they can learn and master (White 1959). If these conditions are not provided, the risk of adverse health outcomes may increase. High quality personal, are better at teaching and promoting the development of a child's language, as well as maintaining high standards of education (Votruba-Drzal et al. 2004). If schools and kindergartens, additionally, provide high quality personal, the possibility of health promotion is founded.

Social networks supply support for families and children, and act as a buffer towards negative life events. Increased areas for sports, playgrounds and open kindergartens may facilitate and help to construct families and children lacking a social network.

Three words are of importance in a public health strategy for children's mental health: promote, prevent and provide. At a municipality or nationwide perspective, it is essential to *promote* a healthy development in all children. It is crucial to *prevent* disorders from being generated in children at risk of mental disorders (genetic, low SEP, marginalized), and first and foremost: the identification of children with disorders, and *provide* treatment for them (Waddell et al. 2005).

5. Conclusion

In the present study, SDQ proves to be a useful tool to monitor mental health in children from Norway. There are some considerations with the instrument, but the construct validity is satisfactory. In order to use the instrument correctly, it is of importance to include the impact supplement. Symptoms alone do not provide information on the burden and impairment for the child, family and environment.

The pattern and prevalence of ADHD and depression/anxiety gives an overall impression that is comparable to other recent surveys focusing on child mental health (Costello et al. 2003b; Fleitlich-Bilyk & Goodman 2004). Although we confirm that somatic complaints coexist with the development of depression/anxiety in children with ADHD, we do not know the onset of somatic complaints, and it limits this study to draw conclusions of causality. Therefore it is important to address the possibility of comorbidity with depression/anxiety in children with ADHD when interpreting their somatic complaints.

We also extended our own and the work of others (Al Hamed J. 2008; Chen et al. 2002; Heiervang et al. 2007), into the area of an inverse relationship with parental SEP. One of the reasons for doing so, was to explore a possible identification of the same pattern as in the adult population in the Nordic countries, where somatic complaints, ADHD and depression/anxiety to a large degree occur with higher prevalence in lower social positions (Adler et al. 1993; Adler et al. 1994; Bernfort et al. 2008; Bjelland et al. 2008; Butterworth et al. 2012; Dorner et al. 2011; Virtanen et al. 2011).

As children's mental health problems often precede the development of mental disorders later in life, it is important at an early time point to promote and prevent an adverse outcome, and provide treatment where necessary.

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ADHD with co-occurring depression/anxiety in children: the relationship with somatic complaints and parental socio-economic position

Abbreviated title:

ADHD and depression/anxiety in children: relation to somatic complaints and SEP

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ADHD with co-occurring depression/anxiety in children: the relationship with somatic complaints and parental socio-economic position

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Background: Attention-Deficit/Hyperactivity Disorder (ADHD) and depression/anxiety are often comorbid in children, and consequences of ADHD are more detrimental in lower socio-economic levels. The aim of this study was to compare co-occurrence of ADHD and depression/anxiety with ADHD alone and depression/anxiety alone when the outcome measure is somatic complaints. Additionally, we wanted to examine whether parental low Socio-Economic Position (SEP) were related to occurrence of ADHD alone, depression/anxiety alone, and co-occurrence of the two. **Methods:** The sample consisted of 12,900 parents who participated in a cross-sectional health survey that included Strengths and Difficulties Questionnaire (SDQ) and impact supplement used to define children with ADHD only (n=166), depression/anxiety only (n=378) and comorbidity (n=229). Socio-economic factors were dichotomized into low versus average/high parental socio-economic position (SEP), abdominal pain, neck pain and headache were categorized as somatic complaints. Logistic regression model was used to explore the association between ADHD, depression/anxiety, comorbidity, somatic complaints and SEP. **Results:** Parents described 58 % of the children with ADHD as comorbid with depression/anxiety. Children with ADHD only report somatic complaints when the disorder is co-occurring with depression/anxiety. The prevalence of ADHD, depression/anxiety, or a combination of the two disorders in children, is higher when parents have a low socio-economic position. **Conclusions:** Increased

awareness of the heterotypic nature of ADHD is needed, especially when interpreting somatic complaints. There is a pattern of an inverse relationship between mental health and socio-economic position in children when measured by ADHD and depression/anxiety. **Keywords:** Pre-adolescence, emotional disorder, disruptive disorder, somatic symptoms, socio-economic status. **Abbreviations:** SDQ: Strengths and Difficulties Questionnaire; ADHD: Attention-Deficit/ Hyperactivity Disorder; SEP: Socio-Economic Position; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, fourth edition.

Introduction

Attention deficit/hyperactivity disorder (ADHD) is the most common diagnosed behavioural childhood disorder. Globally ADHD is expected to affect 3-5 % of children, boys four times more frequently than girls (American Psychiatric Association, 1994). There is no single cause why some get ADHD, and no blood sample to diagnose the disorder. It is primarily characterized by a co-existence of problems of attention and hyperactivity, where the outcomes are difficulties controlling attention, concentration and impulsivity (American Psychiatric Association, 1994). There is a genetic liability where the risk of a child being diagnosed with ADHD increases with 57 % when a parent is diagnosed ADHD, and 32 % if a sibling is diagnosed ADHD (Biederman et al., 1995). The prevalence of the disorder is higher in children from low parental socio-economic positions (SEP) (Wadsworth & Achenbach, 2005). In a recent review by Danckaerts and colleagues (Danckaerts et al., 2010) ADHD is associated with poor academic achievement, family- and peer- related problems and co-occurrence of other disorders. The long-term outcome of children with ADHD indicates an increased risk for criminal activity and substance abuse.

The disorder is complicated by its heterogeneity, and evidence suggests high levels of comorbidity between ADHD and conduct (30-50 %), oppositional defiant disorder (40-50 %),

depression (15-75 %) and anxiety disorder (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Fleitlich-Bilyk & Goodman, 2004). Both ADHD and depression/anxiety are associated with significant impairments. The estimated prevalence of depression and anxiety under the age of 13 is 2.2-6.56 % (Bittner et al., 2007; Costello et al., 2003). Because anxiety and depression overlap, there exists a common disorder. They are considered a part of a larger category called internalizing syndrome or negative affectivity, and are both variants of a single mood disorder (Brady & Kendall, 1992). Emotional disorders in children can cause impairment in their health, social life and academic functioning (Beidel, Turner, & Morris, 1999; Honjo et al., 2001).

Children often use somatic complaints as a way to verbalise or express distress (Garralda, 1996), and children with emotional disorders such as depression and anxiety more frequently report somatic complaints than children without, and somatic complaints are therefore regarded as a psychiatric symptom (American Psychiatric Association, 1994; Beidel et al., 1999). Headache, abdominal pain, fatigue, back pain and musculoskeletal pains are the most commonly reported somatic complaints in childhood (Campo & Fritsch, 1994). In some epidemiological studies ADHD is significantly associated with somatic complaints (Egger, Costello, Erkanli, & Angold, 1999; Graetz, Sawyer, & Baghurst, 2005; Holmberg & Hjern, 2006).

There is a strong correlation between mental health and indicators of inequalities in wealth and income (Friedli, 2009). In a longitudinal study based on parental interviews by Wadsworth and Achenbach (2005), on the link between SEP and psychopathology in children, they found a strong support for an association between SEP and somatic complaints, depression, anxiety, thought problems, delinquent and aggressive behaviour. Heiervang and colleagues (2007) described in a longitudinal study of children's mental health a significant association between low household income, low paternal education and an increased

prevalence of DSM-IV disorders in children aged 7-9. The majority of research in the Nordic countries on socio-economic status and health is focused on the adult population. In these countries, where the standard of living is high, a large degree of the adult population, especially in lower SEP, struggles with mental health problems (Bjelland et al., 2008; Dorner et al., 2011; Mackenbach, 2006), causing functional impairments and low levels of quality of life (Al-Windi, 2005; Gjervan, Torgersen, Nordahl, & Rasmussen, 2011). Mental health problems are here the leading cause of absence due to sickness and incapacity benefits (Harvey, Henderson, Lelliott, & Hotopf, 2009). Knowing the severe long-term outcomes of affected health, more research is needed on the relation between SEP and child health (McLaughlin et al., 2011).

The first aim of this study is to compare the risk for having somatic complaints among children with ADHD alone, depression/anxiety alone, or a co-occurrence of ADHD and depression/anxiety. We hypothesize that children with depression/anxiety alone would report higher levels of somatic complaints than children with ADHD alone. Further we hypothesize that children with ADHD and depression/anxiety would report higher levels of somatic complaints than children with ADHD alone. The second aim of this study is to compare the risk of having ADHD and/or depression/anxiety when low parental SEP, compared to ADHD and/or depression/anxiety when average/high parental SEP. We hypothesize an increase in prevalence of ADHD and/or depression/anxiety when decreasing SEP.

Methods

Design and participants

This study is based on data from a cross-sectional health survey of children from third grade primary school to the final year of high school in Akershus County, Oslo 2002. The study was led by the Norwegian Health Service Research Centre after initiative from municipalities in

Akershus County requesting a report of health status and needs for health care services among children and youth. Akershus County surrounds Oslo and consists of 22 municipalities, covering urban, suburban and rural areas, both inland and coastline, with clear socio-economic differences. The present study is based on data from children from 8 to 13 years (3-7 grade primary school), where parents responded to the survey concerning their children. To obtain a representative sample for the County, classes were randomly selected at each school level. Parents received an information letter beforehand on the intention of the study and the need for a written consent. A total number 14,698 (78%) parents participated. The parents received their questionnaires from the children, given them at school. It was returned to school in sealed envelopes, where it was delivered to a contact person for the municipality and from there picked up by the research administrator. Reminders were sent out once, regarding the consent form and answers to parent questionnaire. Lack of response was mainly caused by the children not being at school the day that the questionnaires were given out, which was caused by school trips, sick leaves among others. The study was anonymous and voluntary. Akershus health profile was conducted after approval from the Regional Committee for Medical and Health Research Ethics

The variables of interest in this study were ADHD, depression/anxiety and a combination of these, used as dependent variables, and somatic complaints and SEP used as independent variables. When categorizing the two disorder groups for comparison, four groups were created. The children were categorized as having ADHD or depression/anxiety alone, children positive to both disorders constituted a comorbid group. Children negative to both ADHD and depression/anxiety constituted the control group.

Measures

To measure possible ADHD and depression/anxiety in the children, answers to the Strengths

and Difficulties Questionnaire (SDQ) was used, which is based on the research diagnostic criteria of DSM-IV (American Psychiatric Association, 1994). SDQ is a brief screening measure that includes parent and teacher version for children 4-16 years, self-report version for adolescents 11-16 years, and a parent and preschool professional version for 3-4 year-olds. In this study, the parent version was used. SDQ contains five subscales; peer problems, hyperactivity problems, conduct problems, emotional problems and pro-social behaviour, each consisting of five questions (Goodman, 1997).

To measure ADHD the hyperactivity-inattention subscale of the SDQ is used. The hyperactivity-inattention subscale questions were; "Restless, overactive, cannot stay still for long", "Constantly fidgeting or squirming", "Easily distracted, concentration wanders", "Thinks things out before acting" and "Sees tasks through to the end, good attention span". The scoring of positively worded questions was reversed. Responses were summed up to a total score ranging from 0 to 10, and recoded into three categories (0-4=Low risk, 5=Borderline, 6-10=High risk). To measure possible ADHD, a score of "high-risk" on the SDQ hyperactivity scale (Cronbach's $\alpha=0.76$) score is required.

To assess depression/anxiety, scores from the emotional scale of SDQ questionnaire is used. A score among the 10% high-risk-group is required. Emotional scale questions were; "Often complains of headaches, abdominal pain or sickness", "Many worries, often seems worried", "Often unhappy, down-hearted or tearful", "Nervous or clingy in new situations, easily loses confidence" and "Many fears, easily scared". Responses were given on a 10 point scale (0-2=Low risk, 3=Borderline, 4-10=High risk) (Cronbach's $\alpha=0.66$). Well aware that the emotional scale includes complaints of headache, stomach-ache and sickness, this question was included because of the necessity to assess a total emotional scale score. Pearson correlation between "Often complains of headaches, stomach-aches or sickness" and the variable "somatic complaints" (explained further down), was 0.4.

To measure the impact of problems in everyday life, the extended version of SDQ includes an impact supplement, which was included in the survey. The DSM-IV definition of both ADHD and depression/anxiety requires that the high-risk group answered positively to the following impact question (Cronbach's alpha on impact scale=0.82): "Overall, do you think that your child has difficulties in one or more of the following areas; emotions, concentration, behaviour, or being able to get on with other people?". In addition, duration is essential to characterize ADHD and depression/anxiety, classified as persistency for at least 6 months. Therefore the definition further required at least a 6-month duration in the response to: "How long have these difficulties been present?", with responses being "Less than a month", "1-5 months", "6-12 months", "More than a year". Finally, the definition also required an impact on daily life. Impairment is needed to be present in two or more settings as given by the question: "Do these difficulties interfere with your child's everyday life in the following areas: home, friendship, learning, or leisure activities," and a minimum of three point score. The remaining children, n=12,127 (94 %), negative to ADHD or depression/anxiety constituted the control group. A total of 12,900 (87,8 %) parents completed the SDQ, necessary to determine possible ADHD and depression/anxiety.

Cut-offs designed for the Nordic population was used on the subscales, dividing the population into three groups: 10% high-risk group corresponding to scores >90th percentile, 10% borderline group and 80% low-risk group corresponding to scores <80th percentile. Goodman originally designed SDQ with higher cut-offs, but well-replicated findings of lower mean scores from the Nordic countries, required custom scores (Heiervang, Goodman, & Goodman, 2008; Van Roy, Groholt, Heyerdahl, & Clench-Aas, 2006). Mental health research in children has widely adopted SDQ as an instrument to use with satisfactory external validity against clinical diagnoses (Van Roy, Kristensen, Groholt, & Clench-Aas, 2009).

Somatic complaints included headache, abdominal pain and neck pain, and was assessed by asking the parents the frequency of their child's complaints within last six months, responses being; "Almost every day", "more than once a week", "almost every week", "almost every month", "rarely or never". To be categorized as having somatic complaints, the frequency of at least one complaint, had to be "almost every week" or "almost every day". Headache, abdominal pain and neck pain were also presented individually, using the same dichotomization as for somatic complaints, where "almost every week" and "almost every day" is interpreted as having the specific complaint.

Socio-economic position was assessed by the parents' household income and highest completed maternal and paternal education, where education had four categories: primary, junior high school, high school and university. To create one variable for the socio-economic position (SEP), income was dichotomized into under the average Norwegian salary in 2002, and over the average salary. Education level was dichotomized by at least one parent with education at university level, and no education at university level for either parent. The criteria for low SEP were: income less than, or equal to, one average salary for the whole family in 2002, Norway (Hansen & Skoglund, 2003), and education-level less than university for at least one parent. High/average SEP would then include income above one average salary and at least one parent with education at university level.

Statistical analyses

Analyses were all performed by The Statistical Package for the Social Sciences (SPSS) v17.0 software package, and cases with missing responses in any of the chosen variables were removed from analysis. Associations between ADHD, depression/anxiety and other characteristics of the children and parents, were explored using bivariate and multivariate logistic regression with calculation of odds ratio (OR) and confidence intervals

(95%CI). Variables had a significant effect level at 0.05, and were then adjusted for age and school grade. Cronbach's Alpha was used on SDQ hyperactivity-inattention subscale, emotional subscale and impact scale to explore internal reliability. Correlations of independent variables (gender, grade, somatic complaints and SEP) were explored using Spearman's rho.

Results

Prevalence of children with ADHD, depression/anxiety and comorbidity

Table 1 presents the prevalence of 12,900 children grade 3.-7., with and without ADHD and depression/anxiety or a combination of the two. A total of 773 (6 %) children were positive to ADHD or depression/anxiety, within this group of 773, 229 (29.6 %) children had concurrent comorbidity. According to parent-report, this study defined 1.3 % (166) of the children as having ADHD alone, and 378 (2.9 %) children having depression/anxiety alone, and 229 (1.8 %) having both disorders (see Table 1). Within the group of children with ADHD (395), 58 % had comorbidity with depression/anxiety. The estimate for boys exceeded that for girls, with significant gender differences for ADHD alone (OR = 5.366***), as well as for the comorbid group (OR = 2.419***). There was a slightly increased risk for ADHD in 4th grade (OR= 1.720*).

[Insert Table 1 approximately here]

Somatic complaints and socio-economic position

Table 2 presents the association between the occurrence of ADHD, depression/anxiety and comorbidity, and somatic complaints and SEP. Figure 1 presents the prevalence of somatic complaints in children with ADHD, depression/anxiety, comorbidity and the control group

having none of the diagnoses. ADHD alone was not significantly associated with any of the somatic complaints (Table 2, Figure 1). There was a strong association between depression/anxiety and all somatic complaints with abdominal pain having the highest risk: odds ratio=5.790. Children with depression/anxiety also had the strongest risk for having headache (OR=3.771). When children had both ADHD and depression/anxiety, they were strongly associated with all somatic complaints, but especially for neck pain (OR 4.867) and abdominal pain (OR= 4.919).

[Insert Figure 1 approximately here]

There was a significant association between ADHD, depression/anxiety, comorbidity and low SEP (Table 2), with the comorbid group being most strongly related (OR = 2.737). Among the children with comorbidity 40.9 % of the children constituted the group of low SEP, as opposed to the control group where 19.7 % of children were from low SEP. The moderating effect of SEP on somatic complaints measured by comparing the odds ratio before and after controlling for SEP revealed no significant effects. However, bivariate logistic regression confirmed an association between somatic complaints and low SEP with OR being 1.713***, implying generally more somatic complaints in all children with parents in low SEP.

[Insert Table 2 approximately here]

Discussion

Prevalence and identification of ADHD and depression/anxiety

This study is based on information from a large representative population in Akershus County, with a response rate of 78 %. Selection of the ADHD and depression/anxiety group

was based only on information from parents. Parent reports were available for grades 3 to 7, as opposed to children reports for grades 5 to 7, which led to an increased sample size. In addition, only parents answered questions about the family's socio-economic conditions. Lack of cross-informant comparisons was a limitation. Goodman and colleagues have demonstrated that two informants are best when screening for "true" clinical disorders, but if choosing only one, parent-report is slightly more useful (Goodman, Ford, Simmons, Gatward, & Meltzer, 2003). However, parent-report alone must be interpreted cautiously, accounting for a possible over or under report of the children's mental health. There is no knowledge on the mental status of the responding parent, or which of the parents responded.

When we combined the prevalence of symptoms and impact, 3.1 % of the children in this study, were identified as "high-risk" for ADHD. Global and Norwegian prevalence of ADHD ranges from 3 to 5 % (American Psychiatric Association, 1994), which corresponds well with our findings. We required a persistency of problems of minimum 6 months in compliance with DSM-IV (American Psychiatric Association, 1994). Pillemer and White (1989) demonstrated that memory further back than three months may be unreliable, causing positive cases to be missed because of underestimates and possible recall bias of the burden of psychiatric disorder. We also included the impact supplement as necessary to determine a possible diagnose, in accordance with DSM-IV (American Psychiatric Association, 1994). The reliability of the impact scale and the hyperactivity-inattention scale for the present study was considered to be satisfactory. Different methodologies can result in different prevalence, as Bird (1996) presented in his review. Findings of low prevalence (1.7 %) of ADHD in Norwegian children (Heiervang et al., 2007) might be due to use of SDQ cut-offs designed for an English population, and not determined by the 10 % high-risk group to scores >90th percentile. The overweight of boys with ADHD in this study is in agreement with the literature (Costello et al., 2003). Comorbidity with ADHD and depression/anxiety of 58 %,

agrees with the results of other studies (Canino et al., 2004; Costello et al., 2003), indicating the importance of comorbidity between ADHD and emotional disorders. The lack of a gender difference in the prevalence of depression and anxiety, is a pattern seen with cross-cultural consistency (Costello et al., 2003; Heiervang et al., 2007), and a prevalence of 4.7 % children with depression/anxiety are acceptable compared to other findings (Bittner et al., 2007; Canino et al., 2004).

SDQ is reported to have moderate-to-high predictive sensitivity for detecting ADHD and depression/anxiety, with a good test-retest reliability (Goodman, 1999; Ullebo, Posserud, Heiervang, Gillberg, & Obel, 2011). But it is important to note that defined cases of disorders were lacking clinical validity, requiring most results to be interpreted with caution. However, significant correlations reported in this study, do identify high risk groups, and by using only clinically diagnosed children, the socio-economic factor might have been lost (Wadsworth & Achenbach, 2005). Families of low SEP pay fewer visits and have less access to doctors (Sacker, Firth, Fitzpatrick, Lynch, & Bartley, 2000), additionally, the help they receive is of poorer quality than higher socio-economic families (Williams, 1990). This poor quality or lack of seeking help, can potentially lead to later diagnosed children and more severe outcome caused by deferred diagnosis.

Somatic complaints in children with ADHD and/or depression/anxiety

The first aim of this study was to examine the association between somatic complaints, ADHD and/or depression/anxiety. It was desired to clarify if the presence of significant somatic complaints in children with ADHD, actually was a result of comorbidity with depression/anxiety. Children with ADHD alone had no association with headache, neck pain or abdominal pain. If they were comorbid with depression/anxiety, they had significant associations on all somatic complaints, and even higher risk for neck pain than

depression/anxiety alone. Our results stress the importance of addressing the issue of comorbidity with depression/anxiety in children with ADHD, when interpreting somatic complaints. However, we cannot clarify any causal relationship because of the study design. It is important to note the term somatic complaints, not to be confused with a somatisation syndrome, which is psychological distress or difficulty expressed through somatic symptoms without any pathological findings (Garber, Zeman, & Walker, 1990; Garralda, 1996). Taken into account, that some of these children actually had physiologically explained symptoms, the term somatic complaints were used.

Often, there is no medical cause for somatic complaints (Roth-Isigkeit, Thyen, Raspe, Stoven, & Schmucker, 2004), leaving these findings in 80 % of the cases to be related to anxiety, and in approximately 40 % of the cases related to depression (Campo et al., 2004; Jellesma, Rieffe, Terwogt, & Kneepkens, 2006). Both Egger and colleagues (1999), and Holmberg (2006) demonstrated a significant association with ADHD and abdominal pain, neither one considered the possibility of ADHD as comorbid with depression or anxiety.

The inverse association with low socio-economic position

The relationship between low parental SEP and child mental health is multifaceted. Income is an integral, but partial determinant of health outcomes, and low parental education is not synonymous with a lack of knowledge or understanding. But this relationship is important to clarify for a well-structured public health policy to be able to prevent or intervene at an early stage. This study left no doubt concerning a higher prevalence of children having ADHD, and/or depression/anxiety among children in families of low SEP. The risk for ADHD in children with low parental SEP was almost doubled, and nearly 1.5 times more likely to meet the diagnostic criteria for depression/anxiety compared to children with parents in a average/high SEP. The risk for having both ADHD and depression/anxiety were strongest

when the child were in a family of low SEP (OR=2.737***). This group also demonstrated a severe association with all somatic complaints, suggesting these children to be especially susceptible. Additionally they are at risk of limited access to health services.

There are no unambiguous etiological explanations to ADHD, the causes are multifactorial with strong genetic liability. A parent with ADHD leaves his/her child with a risk to be diagnosed with ADHD about 57 %, and if it is a sibling diagnosed ADHD, the risk increases with 32 % (Biederman et al., 1995). Genetic vulnerability can be aggravated by social hardship, causing children who are born into a family with low SEP to start their life more disadvantaged compared to children born into a family of high SEP. Additionally the prevalence of ADHD is higher in the adult population with low SEP, compared to the prevalence in the population with average/high SEP. This increases the chance that a child living in a family with low SEP, inherits the disorder.

Conclusions

Our results of prevalence of ADHD, depression/anxiety and comorbidity in children are generally consistent with those provided in previous research. However, there is a need for understanding the development of psychopathology in children, in order to provide the best treatment. It is important to be aware that ADHD is rarely homotypic when diagnosing children. This study implies that somatic complaints in children with ADHD, may be a symptom of concurrent comorbidity with depression or anxiety.

Socio-economic differences do appear when prevalence of ADHD, depression/anxiety and comorbidity in children is measured. This corresponds to findings in the adult population.

There is still a lot of research to be done to explain the symptomatic outcome of comorbid disorders in children with ADHD. The recognition of an inverse relationship in

parental SEP and prevalence of both ADHD and depression/anxiety in children, may improve strategies to detect at an early stage and thus possibly intervene.

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Keypoints:

- Children with ADHD are often co-current comorbid with depression or anxiety.
- It is important to consider depression or anxiety when interpreting somatic complaints in children with ADHD.
- There is an inverse relationship between parental socio-economic position and prevalence of ADHD and/or depression/anxiety in children.

Table 1: Prevalence of 12,900 children with type of disorder, gender, primary school grade, somatic complaints and socio-economic position.

Characteristics	n= 12,900
Boy	6,490 (50.3)
Girl	6,410 (49.7)
Primary school grade	
3rd	2,644 (20.5)
4th	2,658 (20.6)
5th	2,593 (20.1)
6th	2,516 (19.5)
7th	2,489 (19.3)
Disorders	
Control-non of mentioned disorders	12,127 (94)
ADHD	166 (1.3)
Depression/Anxiety	378 (2.9)
ADHD and Depression/Anxiety	229 (1.8)
Somatic complaints	
No	11,484 (89)
Yes	743 (5.8)
Socio-economic position	
Low socio-economic position	2,537 (19.7)
Average/high socio-economic position	9,675 (75)

Table 2: Logistic regression analysis examining the association between ADHD alone, depression/anxiety alone or comorbidity of the two, and the association of somatic complaints and socio-economic position.

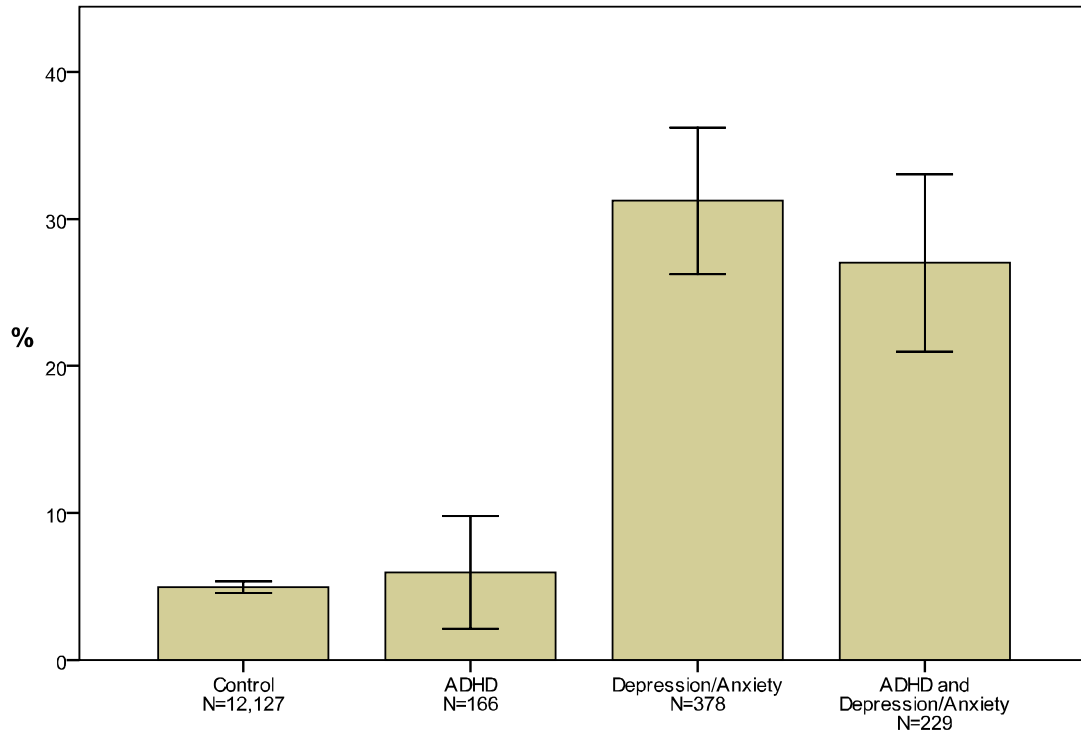
		ADHD OR (95% CI)	Depression/anxiety OR (95% CI)	Comorbidity OR (95% CI)
Somatic complaints	No headache	1.	1.	1.
	Headache	1.219 (0.426-3.493)	3.771 (2.611-5.445) ***	3.335 (2.039-5.455) ***
	No abdominal pain	1.	1.	1.
	Abdominal pain	1.641 (0.576-4.675)	5.790 (4.042-8.295) ***	4.919 (3.041-7.957) ***
	No neck pain	1.	1.	1.
	Neck pain	0.626 (0.085-4.625)	2.555 (1.530-4.267) ***	4.867 (2.791-8.489) ***
Socio-economic position	Average/high	1.	1.	1.
	Low	1.941 (1.380-2.731) ***	2.465 (1.971-3.082) ***	2.737 (2.063-3.630) ***

OR=Odds-ratio, CI= confidence interval. Adjusted for gender and primary school grade.

Reference category is: Control –negative to ADHD or depression/anxiety.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1: Prevalence (%) of somatic complaints in children with ADHD alone, depression/anxiety alone, comorbidity of the two, and control (neither of the disorders). Error bars shows CI 95%.



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Appendix

- A:** DSM-IV criteria for ADHD
- B:** Author guidelines for “Journal of child psychology and psychiatry”
- C:** Copy of approval for the Akershus health profile, from the Regional Committee for Medical Research Ethics
- D:** The Strengths and Difficulties Questionnaire (SDQ) and impact supplement

A: DSM-IV Criteria for ADHD

I. Either A or B:

- A. Six or more of the following symptoms of inattention have been present for at least 6 months to a point that is inappropriate for developmental level:**

Inattention

1.
 1. Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities.
 2. Often has trouble keeping attention on tasks or play activities.
 3. Often does not seem to listen when spoken to directly.
 4. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions).
 5. Often has trouble organizing activities.
 6. Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time (such as schoolwork or homework).
 7. Often loses things needed for tasks and activities (e.g. toys, school assignments, pencils, books, or tools).
 8. Is often easily distracted.
 9. Is often forgetful in daily activities.

- B. Six or more of the following symptoms of hyperactivity-impulsivity have been present for at least 6 months to an extent that is disruptive and inappropriate for developmental level:**

Hyperactivity

1.
 1. Often fidgets with hands or feet or squirms in seat when sitting still is expected.
 2. Often gets up from seat when remaining in seat is expected.
 3. Often excessively runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless).
 4. Often has trouble playing or doing leisure activities quietly.
 5. Is often "on the go" or often acts as if "driven by a motor".
 6. Often talks excessively.
1. **Impulsivity**
2.
 7. Often blurts out answers before questions have been finished.
 8. Often has trouble waiting one's turn.
 9. Often interrupts or intrudes on others (e.g., butts into conversations or games).

- II.** Some symptoms that cause impairment were present before age 7 years.
- III.** Some impairment from the symptoms is present in two or more settings (e.g. at school/work and at home).
- IV.** There must be clear evidence of clinically significant impairment in social, school, or work functioning.
- V.** The symptoms do not happen only during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder. The symptoms are not better accounted for by another mental disorder (e.g. Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder).

Based on these criteria, three types of ADHD are identified:

- IA. ADHD, *Combined Type*: if both criteria IA and IB are met for the past 6 months
- IB. ADHD, *Predominantly Inattentive Type*: if criterion IA is met but criterion IB is not met for the past six months
- IC. ADHD, *Predominantly Hyperactive-Impulsive Type*: if Criterion IB is met but Criterion IA is not met for the past six months.

American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision. Washington, DC, American Psychiatric Association, 2000.

B: Author guidelines for “Journal of child psychology and psychiatry”

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C: Copy of approval for the Akershus health profile, from the Regional Committee for Medical Research Ethics

REGIONAL KOMITE FOR MEDISINSK FORSKNINGSETIKK

Helseregion Øst

Seniorforsker Jovelyne Clench-Aas
HELJEF – Stiftelse for helsestjenesteforskning
1474 Nordbyhagen

Deres ref:

Vår ref.: 40-02022

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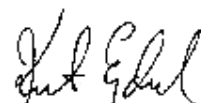
Helseprofil for barn og ungdom i Akershus

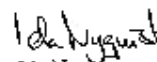
Regional komite for medisinsk forskningsetikk, helseregion Øst, vurderte prosjektet på sitt møte 25.01.02.

Komiteen vil ikke motsette seg at studien blir gjennomført.

Komiteen synes at spørreskjemaundersøkelsen er svært omfattende og lite fokusert, og er noe i tvil om hva søker kan få ut av en slik undersøkelse. Det savnes en redegjørelse både for hvordan man har tenkt å følge opp med tiltak, og for evaluering av tiltakene.

Med vennlig hilsen


Knut Engedal
professor dr.med.
leder


Ida Nyquist
sekretær

D: The Strengths and Difficulties Questionnaire (SDQ) and impact supplement

Strengths and Difficulties Questionnaire

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For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour over the last six months.

Child's Name

Male/Female

Date of Birth.....

	Not True	Somewhat True	Certainly True
Considerate of other people's feelings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Restless, overactive, cannot stay still for long	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often complains of headaches, stomach-aches or sickness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shares readily with other children (treats, toys, pencils etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often has temper tantrums or hot tempers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rather solitary, tends to play alone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generally obedient, usually does what adults request	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many worries, often seems worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helpful if someone is hurt, upset or feeling ill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Constantly fidgeting or squirming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Has at least one good friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often fights with other children or bullies them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often unhappy, down-hearted or tearful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generally liked by other children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easily distracted, concentration wanders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nervous or clingy in new situations, easily loses confidence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kind to younger children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often lies or cheats	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Picked on or bullied by other children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often volunteers to help others (parents, teachers, other children)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thinks things out before acting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Steals from home, school or elsewhere	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gets on better with adults than with other children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many fears, easily scared	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sees tasks through to the end, good attention span	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have any other comments or concerns?

Please turn over - there are a few more questions on the other side

Overall, do you think that your child has difficulties in one or more of the following areas: emotions, concentration, behaviour or being able to get on with other people?

No	Yes- minor difficulties	Yes- definite difficulties	Yes- severe difficulties
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If you have answered "Yes", please answer the following questions about these difficulties:

• How long have these difficulties been present?

Less than a month	1-5 months	6-12 months	Over a year
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

• Do the difficulties upset or distress your child?

Not at all	Only a little	Quite a lot	A great deal
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

• Do the difficulties interfere with your child's everyday life in the following areas?

	Not at all	Only a little	Quite a lot	A great deal
HOME LIFE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FRIENDSHIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CLASSROOM LEARNING	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LEISURE ACTIVITIES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

• Do the difficulties put a burden on you or the family as a whole?

Not at all	Only a little	Quite a lot	A great deal
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Signature

Date

Mother/Father/Other (please specify:)

Thank you very much for your help

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