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Language Impairments in Children With ADHD in Norway.

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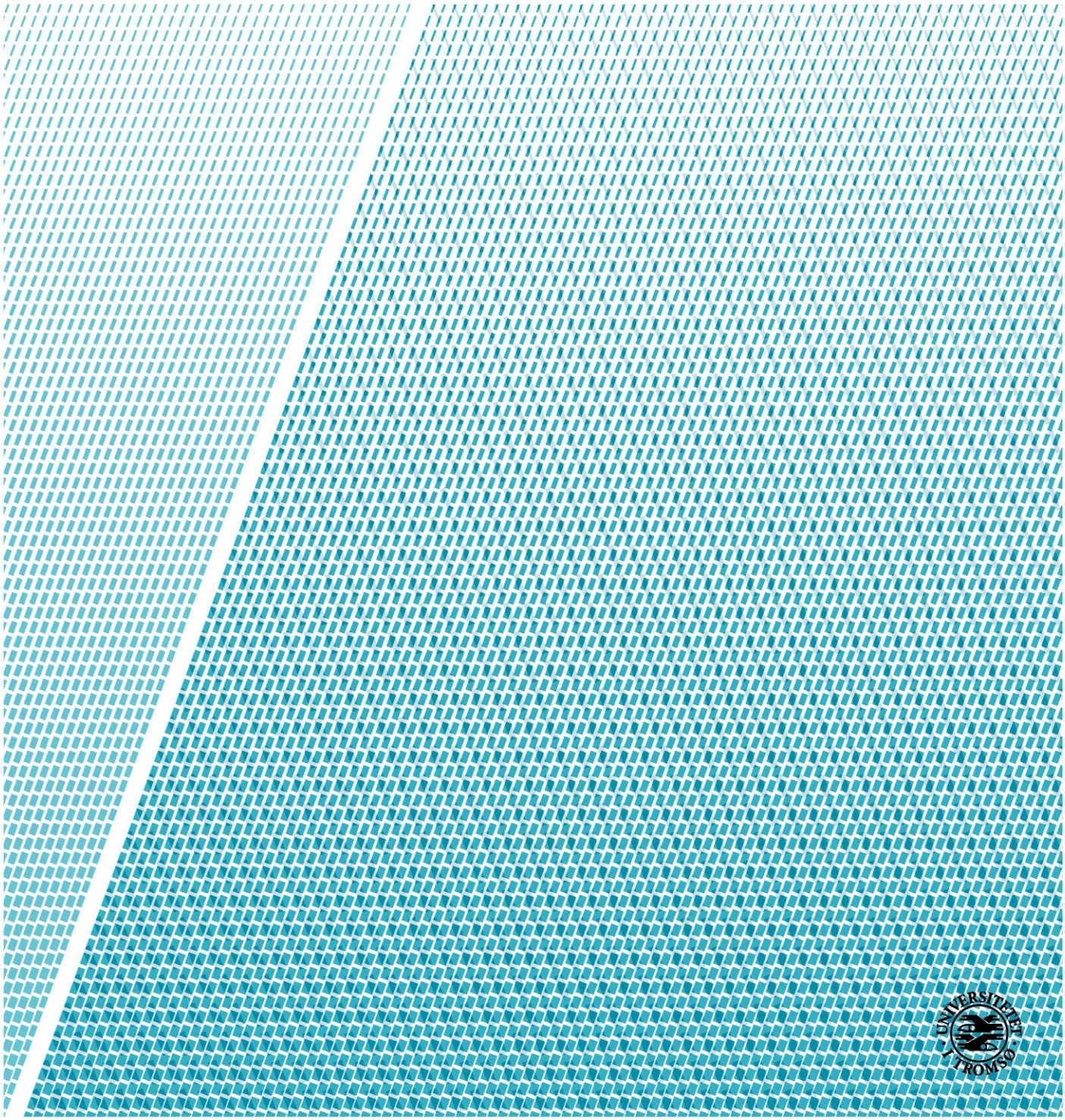
Master thesis in medicine (MED-3950)



Preface

The aim of this pilot study was to explore prevalence of language problems in children with ADHD, and to further examine what characterizes children in this group. The project was established in the fall of 2017 when I contacted my main supervisor Siv Kvernmo, a professor in child and adolescent psychiatry at UiT the Arctic University of Norway. She told me about the ongoing study done by Judeson Joseph, a child psychiatrist at the university hospital. This study was examining the influence of Omega-3 fatty acids on ADHD-symptoms. In this study, the children undergo a series of testing using different screening tools and surveys under the follow up period. After meeting with both Siv Kvernmo and Judeson Joseph, we agreed on what tests/surveys to use in order to best explore the characteristics of children with ADHD and comorbid language problems. I am very thankful for the help provided by both in this part of the process. Judeson Joseph also needs to be credited for his fantastic work with the protocol for his study, which I have used in this paper to explain how the data is collected and how the study is conducted. A note of appreciation also goes out to all the people at the paediatric research group at the UiT and the University Hospital of North Norway who have contributed to the original study by Judeson Joseph giving me the opportunity to write this paper. Finally, I have to state my appreciation of all the help I have got during this project with statistic advice and guidance in the writing process from my main supervisor Siv Kvernmo, without whom this paper would not exist.

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Abstract

Introduction: The aim of this study was to examine the prevalence of language problems in a sample of children with ADHD/ADD and to explore the characteristics of these children regarding gender, age, mental health, ADHD-symptoms and IQ.

Methods: The data consisted of 46 children with ADHD/ADD. "Språk 6-16", a Norwegian screening tool for language problems was used to measure language function, and scores below the reference level was defined as a possible language problem. The tests ADHD-rating scale, Strengths and Difficulties Questionnaire and WISC-IV/WPPSI where used as explanatory variables, in addition to gender and age. Differences between children with normal language function and children with a language problem was examined by using independent t-tests for continuous variables and Chi-square tests for categorical variables. A stepwise bivariate logistic regression analysis was conducted to examine how the explanatory variables affected language function.

Results: Prevalence of language problems was 13.04% in the total sample. No gender difference for language problems was found. More children with language problems was found in the age group 6-10 compared to the age group 11-16. Age was also a significant predictor of language problem when adjusting for gender and IQ in the bivariate regression analysis. The language problem group had significantly lower mean scores on the WISC-IV on perceptual reasoning, processing speed index and full scale IQ compared to the group with normal language.

Conclusion: Prevalence of language problems was 13.04%, lower than in several other studies. Explanatory factors could be differences in study population, definitions of language problems and screening tools used to assess language problems in the various studies. Studies on language problems in ADHD is incoherent, and more research is needed on the subject.

1 Background

This paper is a pilot study on data collected in the study «ADHD and nutrition: The influence of omega-3 on ADHD related symptoms». The study is performed by the unit for children and adolescent psychiatrics and clinical research centre at the University hospital of Tromsø, Northern Norway. In the main study, the aim is to examine the effect of omega-3 fatty acids on symptoms related to attention deficit/hyperactivity disorder (ADHD). In the omega-3 fatty acids study, the children is to undergo a series of neuropsychiatric examinations and tests over the one year follow up(1). Each child has four follow up interviews throughout the year. The child's parents and teacher also fill out internet-based forms throughout the year. The tests used in this pilot study is "Språk 6-16", a Norwegian test for language abilities, "Wechsler Intelligence Scale for Children, WISC" or "Wechsler Preschool and Primary Scale of intelligence, WPSSI", both intelligence tests for children, "ADHD-rating scale", a test that assesses the severity of ADHD symptoms and what symptoms that are most prominent in the child and "Strengths and difficulties questionnaire, SDQ" a behaviour screening for children. The age and sex of the children will also be implemented in the study as confounding factors.

The aim of this pilot study is to examine language problems in children with ADHD. Language problems is quite common in children with ADHD, and this study seeks to find the prevalence of language problems in Norwegian children aged 6 to 16 with an ADHD/ADD diagnosis. In addition, we want to see whether the prevalence in Norwegian children is similar to the prevalence in other countries that Norway can be compared to. The study will also take into account confounding factors like age, gender, IQ and subtype of ADHD to examine if these factors influence language abilities in children with ADHD. When addressing hyperkinetic disorder in this paper, the term ADHD will be used, even though some of the participants have ADD diagnosis.

Hypothesis

This study will try to answer the following postulations:

1. Children with ADHD have a higher prevalence of language problems compared to children without an ADHD-diagnosis.
2. The prevalence of language problems in Norwegian children with ADHD is not different from prevalence found in other comparable studies from other countries.
3. IQ in children is not significantly different in children with language problems and ADHD/ADD compared to children with ADHD/ADD only.
4. Subtype of ADHD (Impulsive/hyperactive or inattentive or combined/mixed) has a confounding role in whether the child with ADHD has a comorbid language problem.
5. Language problems in children with ADHD has a higher prevalence among girls compared to boys.
6. There is a higher risk of having language problems the higher the age of the child with ADHD

Hyperkinetic disorder is one of the most frequent psychiatric diagnosis used among children and adolescents in Norway. A study using the Norwegian Patient Registry and Norwegian Mother and Child Cohort Study estimated that 5,4% among boys and 2,1% among girls at 12 years of age have got a diagnosis of hyperkinetic disorder(2). In ICD-10 Hyperkinetic disorder is described as a group of disorders where lack of persistence in activities that require cognitive involvement, impatience for activities and a tendency to change activities and symptoms of disorganized and excessive activity is central. Children with hyperkinetic disorder might also experience recklessness, peer problems, conduct problems specific delay in language and motor development and low self-esteem(3). The symptoms of ADHD must be present in two or more settings, lead to a loss of function and must be apparent before the age of seven(4). These criteria are not very different from the criteria described in DSM-V defined by The American Psychiatric Association. In DSM-V, 9 symptoms of Inattention and 9 symptoms of Hyperactivity/Impulsivity are listed. In children and adolescents up to 16 years, six symptoms of inattentiveness, hyperactivity/impulsivity or both is needed. For adolescents and adults, five symptoms are sufficient. As in ICD-10, the symptoms must be present in two or more settings and have a negative impact on the level of function of the child or adolescent. In DSM-V, the symptoms must be present before age 12 (4).

The participants in the study have already been diagnosed with hyperkinetic disorder/ ADHD or ADD after examination according to the national guidelines in Norway. The national guidelines suggest that developmental history, assessment of symptoms in various situations, function in several settings, observation, psychiatric interviews, screening tests and questionnaires are conducted before deciding on a diagnosis. Some studies define ADHD in children as either predominantly inattentive, hyperactive/impulsive or combined based on what kind of symptoms which is most prominent in the child. A similar approach will be used in this study by using scores from the ADHD- rating scale.

Language impairment or language problems is a prevalent problem among children. According to some sources, the prevalence of developmental language disorders is 5-10% (5). Language disorder is defined as an impaired comprehension and/or use of spoken or written word. Language disorders is a complex illness, and may involve several aspects of

language such as form (grammar, syntax, and morphology), content (vocabulary) or function (pragmatic use) of language(5).The child may have problems with several of the aspects of language or just one area, determined by the severity of the illness. Important differential diagnoses and causes to language disorders are intellectual disability, attention deficit hyperactivity disorder, learning disabilities, autism/pervasive developmental disorder, traumatic brain injury, neglect/abuse, hearing loss and many other neurodevelopmental diseases(5). Because of the high comorbidity of other neurological/neurodevelopmental diseases when having a language disorder, a challenge in a study like this is to design the study in a way that excludes every participant who might have a language impairment for other reasons than ADHD/ADD. Several studies have tried to examine the prevalence of language problems in children with ADHD. The prevalence of language problems in children with ADHD vary from 67% to approximately 15 % in the studies used in this article. Several of the studies have found prevalence of language problems in the ADHD affected children to be approximately 40-45 %. The studies presented in Table 1 are studies with different study designs and from several different countries. All studies are from high income countries that are somewhat comparable to the sample in this data set with children from all over Norway. All studies cited in this section (6-11) are summarized in table 1.

Table 1 Prevalence of language problems in children with ADHD found in various studies.

Country	Authors and title	Type of study	Prevalence language problems
Israel	Tirosh, E., & Cohen, A. (1998). Language Deficit With Attention-Deficit Disorder: A Prevalent Comorbidity.	Cross sectional study	45%
Australia	Sciberras E, Mueller KL, Efron D, Bisset M, Anderson V, Schilpzand EJ, et al. Language problems in children with ADHD: a community-based study.	Case-control study	40%
Canada	Cohen, N., Vallance, D., Barwick, M., Im, N., Menna, R., Horodezky, N., & Isaacson, L. (2000). The Interface between ADHD and Language Impairment: An Examination of Language, Achievement, and Cognitive Processing.	Cross sectional study	42%
Sweden	Bruce, B., Thernlund, G. & Nettelbladt, U. ADHD and language impairment	Case-control study	67%
Denmark	Jensen CM, Steinhausen HC. Comorbid mental disorders in children and adolescents with attention-deficit/hyperactivity disorder in a large nationwide study.	Retrotrospective register study.	15,4%
Sweden	Kadesjø B, Gillberg C. The Comorbidity of ADHD in the General Population of Swedish School-age Children	Cohorte (population based)	40%

A recent systematic meta-analytic review on language problems in children with ADHD where 21 studies was included found that 60 out of 68 separate analyses showed significant differences in the control groups and the ADHD-groups regarding language measures(12). Separate analyses were conducted for expressive, receptive and pragmatic language, and the ADHD group scored significantly lower in every category, and especially low in tests for expressive language (12). However, this does not correlate with findings in a Norwegian study where the object was to examine if there was a difference between children with

ADHD, reading disorder, ADHD and a reading disorder and healthy controls in the different aspects of language(13). In this study, children with ADHD perform poorer than the healthy control group in every aspect of language, but especially poor in receptive language. This finding corresponds well with other studies showing that children with ADHD have problems with receptive language. In fact, one study (14) found that receptive language/ comprehension problems is three times as common than expressive language impairments in children with ADHD. This corresponds to other studies that also find children with ADHD to have less impaired function in phonology and expressive language (15, 16).

A longitudinal twin- study at Kings College in London with approximately 7000 twin pairs examined the association between ADHD-symptoms and reading skills (17). The results from this study showed that ADHD-symptoms is a significant predictor for reading disability, and reading disability is also a significant predictor for ADHD. The study also investigated the correlation between type of ADHD symptoms and its effect on reading disability in children with ADHD. The result showed that both inattentive and hyperactive/impulsivity symptoms significantly contribute to predicting reading disability, but the inattentiveness proved to be a stronger predictor in this particular study. ADHD-symptoms is thought to also affect language impairments in the same way as it affects reading ability, and this study aims to assess whether language problems/ impairments is most prominent in children with mainly inattentive, hyperactive/impulsive or mixed/combined symptoms of ADHD. In a community-based study in Melbourne Australia, language problems and academic function in children with ADHD was compared to a control group of children without an ADHD diagnosis (7). In the group with a mixed/combined type of ADHD, the prevalence of language problems was 47%. In the hyperactive/impulsive group the prevalence of comorbid language problems was 36%, and in the inattentive group the prevalence was 33% (7). The odds ratio for children with ADHD to have a comorbid language problem was 2,8 with a 95% CI of 1, 5 to 5, 1 after adjusting for confounding factors and sociodemographic factors. The same study also showed that children with ADHD and comorbid language problems have a lower academic achievement overall compared to children with only ADHD, and they did significantly poorer in both in reading and math computation as well. This suggests that language and sufficient language abilities is an important part of the foundation for a child to show academic

achievement in school, and raises the question that children with ADHD should be screened for language problems at an early stage to prevent underachievement later in their school life as suggested in earlier studies (7, 12). For children with ADHD, as with all children, self-confidence and perception of one self as competent regarding school activities is important and affects the child's academic performance (18). Early follow up of children with ADHD and language problems by teachers and others might therefore give the child a more positive school experience and a better basis to prevent further academic underachievement.

An older study done on language problems in children with ADHD (19) set out to see whether there was any gender differences in children with ADHD. In this study (19), girls with ADHD turned out to have a more severe cognitive impairment, particularly in the area of language function. Gender difference in children with ADHD have been subject to several other studies as well. According to two separate meta- analyses (20, 21), girls with ADHD have greater intellectual impairments than boys with ADHD. Gender differences in children with ADHD and language impairment is not as much studied as overall gender differences in children with ADHD. In the Australian population based case-control study (7), it was concluded with no significant difference between the genders regarding language problems and ADHD. This is in contrast to another population based study (6) where a significantly higher proportion of girls compared to boys was found in the ADHD and language problem group than in the group containing children with only ADHD.

In a study on ADHD and comorbid language problems (6) the association between language function and IQ was examined. Wechsler full scale IQ of children in the ADHD and language problem group is significantly lower than in the control group without language problems, scoring 104.9, 6.1 SD, and 107.6, 5.7 SD, respectively(6). In the same study, short term memory was lower in the ADHD and language problem group compared to controls with ADHD alone. A study examining the structural validity of the WISC-IV for students with ADHD (22) concludes that the general intelligence factor provides the most reliable information on intelligence in this group of patients, and therefore only full scale IQ should be evaluated when interpreting WISC-IV scores in children with ADHD(22). In the current study, one seeks

to examine both whether language function in children with ADHD is associated with gender, and if language function is affected by IQ measures. Another aim of this study is to examine whether symptoms of ADHD affects language function. As mentioned in the two meta- analyses previous in this section (20, 21), girls with ADHD are found to have greater intellectual impairments than boys with ADHD, while boys experience more symptoms of ADHD. Based on this, one could assume that more girls in this study are found to have a language problem if language problems are associated with intellectual ability. Likewise, one can imagine that more boys are found to have a language problem in this study if symptoms of ADHD have an effect on language function.

2 Methods

2.1 Study design

As noted earlier, the data in this paper is collected from another ongoing study, and the study design explained in this section is a description of the original study "ADHD and nutrition: The Influence of omega-3 on ADHD related symptoms". The study has a randomized double-blind control design. Participants are children with an ADHD or ADD diagnosis between 6 to 16 years of age. Children who are currently receiving medicinal treatment get a one-month medication free quarantine before they can be included in the study. The children are randomized into two groups. One group are receiving Omega-3 capsules, and the other group are receiving placebo with paraffin capsules. Six capsules will be taken daily and will be handed out to the families at the time for the study visits. The remaining capsules have to be brought back after week 26. No medicinal treatment for ADHD or ADD is given in the 6 month capsule period. To include the participant in the analyses at least 70% of the capsules must have been taken. Prior to the intervention the children will undergo testing regarding cognitive function, attention span, reading and writing skills, blood and urine tests and a physical examination. The blood and urine tests will be repeated immediately after digestion of the last gel capsule and then after approximately 52 weeks (12 months follow-ups). The subjects/caregivers and the health personnel being in contact with the children during the study period will be blinded regarding to the content of the gel capsules. The patients/care givers and the clinicians will record adverse effects of the intervention or the placebo. If the participants experience any adverse effects or have any questions, the parents/ caregivers will have the possibility to contact a physician at any time during the study. Any contact, and the purpose of it, will be documented(1)

A statistician not involved in the study, and according to a randomization code drawn up in advance will assign group allocation. Medical and nevropsychological examinations will be centred to three main child and adolescents mental health clinics, BUPA Tromsø, BUPA Nordlandssykehuset, and BUP Karasjok, Finnmarkssykehuset by using few and well-trained clinicians(1).

2.2 Criteria for inclusion and exclusion

As this research is a pilot study based on data collected in the project «ADHD and nutrition: The influence of omega-3 on ADHD related symptoms» at the University hospital of Northern Norway, the inclusion criteria are made specifically for that study, and not for the issue subject to this pilot. However, this is not a big concern, as the criteria are fairly suitable to this study as well.

Inclusion criteria

Children with an ADHD or ADD diagnosis between 6 to 16 years of age can take part in the study. Children who are currently receiving medicinal treatment get a one-month medication free quarantine before they can be incorporated in the study. The child cannot receive medicinal treatment for ADHD or ADD in the six-month intervention period where the Omega -3 or paraffin capsules are administered.

Exclusion critera

- An IQ score below 70, illness or suspected illness in the autism spectre, psychosis or suspected psychosis, suspected or known bipolar disorder or other psychiatric disease will lead to exclusion.
- Severe somatic illness or pathological blood samples at the inclusion point that needs medical treatment leads to exclusion.
- If the child has received medical treatment for ADHD the last month or are currently on ADHD medication it will lead to exclusion from the study.
- Oral intake of Omega-3 supplements 3 months prior to the study will lead to exclusion.

2.3 Measures

The tests used in this study is “Språk 6-16” (Language screening test), Wechsler Intelligence Scale for Children (WISC) or Wechsler Preschool and Primary Scale of Intelligence (WPPSI), ADHD-rating scale (ADHD-RS) and Strengths and Difficulties Questionnaire (SDQ). In addition, the sociodemographic factors age and gender will also be taken into account and analysed for confounding effect on language problems in children with ADHD.

Language problems in children in this study is examined by using the screening test “Språk 6-16”, a Norwegian screening test for language impairment(23). This tool is a validated test commonly used in screening for language impairment, and is published by the Norwegian state centre for special pedagogics (Statped). The test is developed for children between the ages 6 and 16, and scaled scores adjusted for the child’s age can be calculated. Norwegian norms have been established. The screening tool consists of three obligatory part tests: “Ordspenn”, (translated meaning word- span), “Begreper” (terms/concepts) and “Setningsminne” (sentence memory/recall). The category “Ordspenn” (word-span) is considered a good test for phonological memory and the ability to hold and understand the vocal structure of sentences. The category “Begreper” (terms/concepts) is considered a good test of the child’s ability to understand the meaning of a word. It is therefore a test of the semantic aspects of language. The last category, “Setningsminne” (sentence memory/recall) is a test where the child’s ability to organize and hold information from sentences is tested. These three test categories combined are used to calculate a total score for language function (23). In addition, the test has several sub-categories or supplementary tests to better examine the language function of the child. These tests are called “Fonologisk bevissthet” (phonological awareness), “Grammatikk” (grammar), “Ordavkoding” (word decoding) and “Lesehastighet” (reading rate). As noted earlier, these supplementary tests are used to give a more nuanced picture of the child’s language function, and would give valuable accessory information in a study like this. Regardless, in this study we have chosen not to use the supplementary tests as the aim of this study is to examine the prevalence of language problems in Norwegian children with ADHD. The supplementary tests are not suitable for all ages, and therefore not all participants will have performed the supplementary tests, and separate test conducted will be a challenge when interpreting the

results regarding language function. In this test, only the scaled scores of the three obligatory test is used as a measure of language problems.

For the part-test “Setningsminne”(sentence recall/memory), 13 sentences of increasing difficulty are read out loudly to the child. The child then has to repeat the sentence to the interviewer. After three uncomplete sentences in a row, the test is stopped and a score is given. For the part- test “Ordspenn” (word-span) 12 tasks are given. The main task in this test is for the child to repeat the chain of words that the examiner reads out loud. The words are read in a rate of approximately one word per second. The first four tasks contain three words in each chain of words. The next four tasks contain four words in each chain of words. The final four tasks contain five words in each chain of words. One point is given for each correct chain of words. If a word is left out, added or the order is incorrect, the score for that word chain is zero. The test stops after three failed chains in a row, or when all of the 12 tasks are completed. The part-test “Begreper” (Terms/concepts) consists of two sub tests. The first is called “Motsetninger”(opposites/contraries) and contains 13 questions or tasks. On the first two tasks, the examiner reads a sentence with a blank space where the child is supposed to find the opposite word of the one used previous in the sentence, for example “Is the lady small or is she ___”. For the next 11 tasks, the examiner reads a word, and the child has to come up with the opposite word. The words read are increasingly difficult. After three wrong answers in a row, the test is stopped. The second sub-test in the category “Begreper” (terms/concepts) is called “Ordkunnskap” (Knowlegde about words). The test contains four questions. The example given in the test is “What is a hat?” The child then has to explain the word, and a point is given if the explanation is similar to the correct meaning of the word. Zero points is given if the answer is obviously wrong, vague or has little or no meaning. All four tasks are usually conducted.

The scores on the three obligatory tests are then converted into scaled scores adjusted for the child’s age. The combined total score on the three part-test are then compared to norm scores based on Norwegian children, and scores under the reference level will be defined as language problems in this study. Scaled scores in each of the three categories of the obligatory test range from 1-19. Maximum score is therefore 57, and minimum score is 3.

Reference level is defined as scores between 21 and 39. A high score indicates a high language function, while a low score indicates a poor language function (23).

To measure IQ the children in the study will also perform the Wechsler Intelligence Scale for Children IV (WISC- IV) or Wechsler Preschool and Primary Scale of Intelligence, (WPPSI -IV). WISC is a historically known instrument, and has long been considered the gold standard of intelligence testing (24). The test provides a full scale IQ, which represents the child's general intellectual ability. WISC- IV also provides four factor measures, or index scores. These are Verbal Comprehension Index (VCI), Processing Speed Index (PSI), Working Memory Index (WMI) and Perceptual reasoning (24). WPPSI is a test of intellectual ability for children aged 2:6-7:7. The test provide primary index scores on several cognitive areas such as verbal comprehension, visual spatial ability, fluid reasoning, working memory, and processing speed (25). The child's overall ability in these cognitive elements can be summarized in a full scale IQ-score that can be compared to a normative reference group (25). A score of 100 is represents the 50^{th} percentile. Reference level for IQ is 1,5 standard deviations above or below the 50^{th} percentile. Scores between approximately 85 and 115 represents normal IQ-scores. Scores above or below this likewise represents abnormal scores. The aim of this study is not to thoroughly examine the intelligence profile of the children with ADHD, but merely to examine whether ADHD and language impairment is associated with intelligence score, and to compare the IQ scores between the children with ADHD and language impairment to the children with ADHD and a normal language function. Regardless, all five scores of the WISC IV is calculated for every child and incorporated in the analysis.

ADHD rating scale IV (ADHD-RS- IV) (α= 0,903), is used in this study to examine to what degree the child experiences symptoms of ADHD, and what subtype of symptoms which is most prominent in the child. The test is available in a home version and a school version. The test takes about 20 minutes, and is to be filled out by the child's primary caretaker (mother, father, grandparents or legal guardian). The school version should be filled out by the child's teacher(26, 27). ADHD-RS- IV contains 18 items on the different symptoms of ADHD noted in DSM-IV. For each of the 18 items, a sentence regarding symptoms of ADHD is stated. The

primary caretaker or the teacher is then supposed to consider how often this symptom occurs in the child with four different options: never/seldom, sometimes, often or very often. ADHD-RS then gives a total score of symptoms, and can also give a score of inattentiveness and a score of hyperactivity/impulsivity. The odd number questions are questions on symptoms of inattentiveness as inattention are described in DSM-IV-TR: "fails to give close attention to details, makes careless mistakes, has difficulties sustaining attention, often easily distracted by extraneous stimuli, often forgetful in daily activities and loses things necessary for tasks and activities"(28). The pair number questions are questions designed to assess symptoms of hyperactivity/impulsivity as described in the DSM-IV-TR: "leaves seat often in the classroom or in other situations in which remaining seated is expected, has difficulty playing or engaging in leisure activities quietly, runs about or climbs excessively and are often "on the go" or driven by a motor" (28). A score of 1,5 standard deviations above the average is interpreted as a pathological/clinically significant score(26, 27).The aim of this study is to examine whether the children with ADHD and language impairment have a higher score on the ADHD-RS and to examine if there is a tendency to more language problems in any of the categories of scores, either the inattentive group, the hyperactivity/impulsive group or the group with combined symptoms. ADHD-rating scale has been conducted several times throughout the follow- up year. In this study, only scores gathered at the first visit will be used. The scores on odd number questions are summarized to provide a score of inattention. The same is done for even numbered questions, and a score of hyperactivity/impulsivity for each participant is calculated. A total score in both categories is also calculated, providing a score of combined symptoms.

Strengths and Difficulties Questionnaire, or SDQ for short, is a brief behaviour screening questionnaire for children 3-16 years of age. It is available as a parent and teacher version for children aged 4-16 (SDQ-P and SDQ-T) and a self-completion version (SDQ-S) for adolescents aged 11-16. The parent version used in this analysis have an (α=0,583) with all 25 items included. To reach an (α >0.7), ten items needed to be removed. We therefore chose to use all 25 items to be able to calculate the separate scores. The original questionnaire made by Robert Goodman was published in 1997 and the first Norwegian translation was published in 1999(29). The SDQ consists of 25 items or attributes, and the 25

items are divided into 5 different scales. The five scales are emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour. The scores are summed individually, and a total score is provided by adding up the scores in the first 4 categories (leaving out the prosocial behaviour category). It is also common to sum up the scales for emotional symptoms and peer problems into a score for internalizing problems, and sum up the scores for conduct problems and hyperactivity/inattention into a score of externalizing problems. Each of the 25 items is answered by scoring the item form 0-2 where 0=not correct, 1= partly correct/somewhat correct and 2= totally correct.

An additional form called "impact supplement" can be answered to assess whether the parent, teacher or adolescent feels that the child/adolescent have a problem. It also assesses for how long it has been a problem and in what way it makes an impact on the life of the adolescent or the family. Five of the questions regarding impact can be summarized into an impact-score(29), (α=0,631) for impact score in this data. Information about how to score and interpret the results of the SDQ is available from https://sdqinfo.org/a0.html. Scores above the 95-percentile is interpreted as very high, scores between the 90 and the 95-percentile is interpreted as high, and a score between the 80 and 90-percentile is interpreted as borderline. All interpretations are based on a British population(30). A study set out to examine the psychometric evidence for the Norwegian version of SDQ found that there are several large population based studies conducted, but that it is not sufficient data to conclude on a national norm for all ages based on Norwegian children (30). It is discussed in this article that one of the larger population based studies(31) compared scores of the SDQ between Norwegian and British children, and found that Norwegian children had lower scores. In the same article (30) it is mentioned Norwegian studies which have established lower cut off values based on the fact that the mean scores are lower in Norwegian children(32, 33). The difference in Norwegian and British scores where only examined in children aged 7-9 years old. In this study, the maximum age is 16 years and the minimum age is 6 years, with a mean age of 10, 61. It is therefore uncertain whether the cut off values should be adjusted to fit with the other Norwegian studies, or if it is best to use the standardised norm from the original test. Because of the age span in the data in this study, and the fact that the difference seen in the above mentioned studies might not be

transferable to all ages, we have chosen to use the standard norm in this study. In this study scores in each of the five categories Hyperactivity/Inattention, Emotional Symptoms, Peer Problems, Conduct Problems and Prosocial Behaviour was calculated. In addition, a total score combining all categories except Prosocial Behaviour was computed. Internalising score and Externalising score was also calculated combining scores for emotional symptoms and peer problems and combining scores in hyperactivity/Inattention and conduct problems respectively. The scores ranged from 0-10 for each score. This gives a maximum score of 20 for each of the internalising and externalising scores, and a maximum total score of 40. An Impact-score using the five last questions of the SDQ was also calculated for each child.

Other factors such as age and gender may play an important role in ADHD and language problems. In this paper, the factors age and gender will be evaluated as separate factors influencing language problems in children with ADHD, as well as synergistic effects with other comorbid factors such as IQ and level of ADHD-symptoms. To evaluate the effect of gender on language problems in children with ADHD, the patients are divided into two groups, one female group and one male group. Prevalence of language problems in the two genders is calculated by dichotomizing into two categories and counting the number of scores below reference level in each of the two groups.

In addition, age is also examined as an individual risk factor for language difficulties in children with ADHD. To examine the effect of age on language problems in children with ADHD, the participants are divided into two groups, one containing the participants from 6-10 years old and the other group containing the participants 11-16 years of age. Prevalence of language problems is calculated by dichotomizing the variable as described above and counting the scores below reference level on the screening test for language problems in each age group. In the regression analysis, age at inclusion point as a scaled variable is used.

2.4 Sample

In total, 67 patients have been enrolled in the main study at the point where the data was collected. 65,7% of the patients in the original dataset are boys, 34,3% are girls. The participants in the original dataset varied in age from 6 to 16, with a total mean age of 10, 61 years. Out of the 67 participants, 46 have completed the three obligatory tests in the language test and are enrolled in the study. The reminding 21 participants have not gone through the tests of wave 1 yet but are enrolled in the study. These participants are therefore excluded from this study. After exclusion the sample consists of 17 girls and 29 boys. This gives a percentage of 37% in the female group and 63% in the male group. After dividing the participants into two age groups, age group 6-10 years consists of 24 participants, and age group 11-16 years consists of 22 participants. This gives a percentage of 52% and 48% in the two age groups.

2.5 Statistics

Statistical Package for the Social Sciences version 25 (SPSS 25) is used to conduct the analyses in this study. Reliability testing for the instruments by calculating Cronbach's alfa (α) was conducted for every instrument with available raw-scores. Test for normality, skewness and kurtosis are done for every scale (Språk 6-16, Wechsler´s Intelligent Scale, ADHD-RS and SDQ) to see if the scores are normally distributed. Test for outliers are run for every scale to examine if there are any extreme values.

To examine for possible differences in explanatory variables between the participants with and without language problems, independent t-tests were used for continuous variables and Chi-square tests for categorical variables. When conducting the chi -square test, it was encountered that the assumptions for the chi-square test was violated by the fact that both the gender and age categories had >20 % of the cells with expected count less than 5. Due to this, the Fisher Exact Test was used.

To examine for collinearity between the explanatory variables, a correlation analyses was conducted as well as collinearity diagnostics in SPSS. A stepwise bivariate logistic regression analysis with group membership in ADHD and ADHD and language problems as the dependent variable was conducted. The explanatory variables gender, age, full scale IQ, total

score ADHD-RS and total score SDQ and impact score SDQ was added in a stepwise procedure to examine the contribution of the different factors on the dependent variable. In step 1, the effect on language problems was adjusted for the sociodemographic factors age and gender. In step 2, full scale IQ was added to the model and adjusted for the sociodemographic factors. In step 3, all the variables of ADHD-symptoms (Total score ADHD-RS, Total score SDQ and Impact score SDQ) was added to the model and adjusted for sociodemographic factors and IQ.

Significance is set at $p < .05$ for all analyses where significance is given.

2.6 Ethics

The ethical aspect in this project is of relevance because the original study where data used in this study is collected is a clinical study involving human beings and the use of biological materials of human origin. In the project plan of the original study (1), several ethical aspects are described. The researchers have accounted for these challenges in the design of the study, and special attention was paid to the handling and management of blood test gathered in this study. Another debated ethical aspect in the project plan was the possible implication of a delay in medical treatment for children participating in this study. This is also accounted for in the project plan, and the design of the study is made in order to prevent as much delay in medical treatment as possible. All ethical aspects are described in detail in the project plan (1), and the original study has been approved by the regional committee of ethics in medicinal research (Regionale komiteer for medisinsk og helsefaglig forskningsetikk, REK).

3 Results

3.1 Characteristics of the sample

3.1.1 Normal Distribution

Test of normality was conducted for the dependent variable and all of the explanatory variables. Figures 1-6 gives a graphic presentation of the normality of the scores on the dependent variable score on the language screening test and the five explanatory variables in the multivariate regression analysis. All of these six scores are normally distributed according to the Shapiro-Wilk-test. The normality tests for each of the explanatory variables are presented in Table 2. As shown in this table, prosocial behaviour, hyperactivity/inattention, emotional symptoms, conduct problems, peer problems and internalizing score from the SDQ have statistical significant scores on the Shapiro Wilk-test with $p < .05$. These scores are therefore not normally distributed, and the results from test executed with these scores is interpreted with caution. The rest of the scores have non-significant scores with $p > .05$ and are normally distributed.

Figure 1 Distribution of scores screening test for language problems.

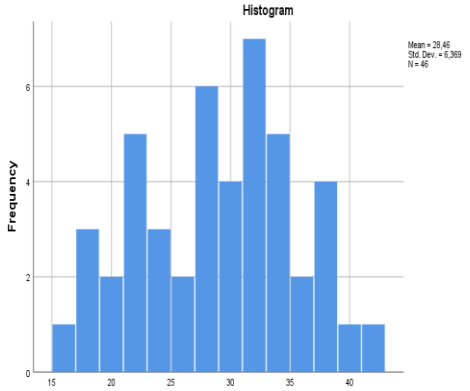


Figure 2 Distribution of score total score SDQ

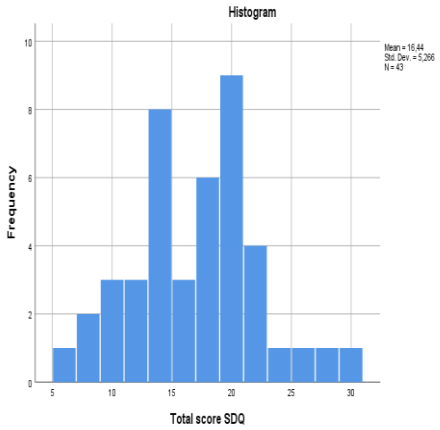


Figure 3 Distribution of scores full scale IQ

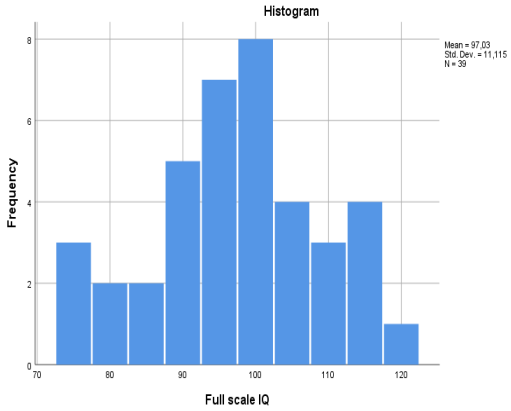


Figure 4: Distribution of scores impact score SDQ

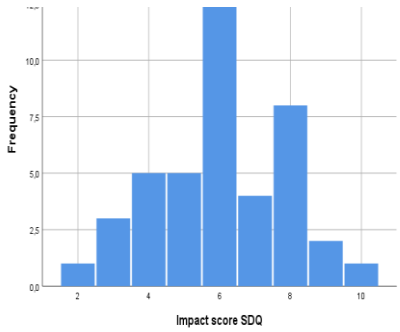


Figure 5 Age distribution

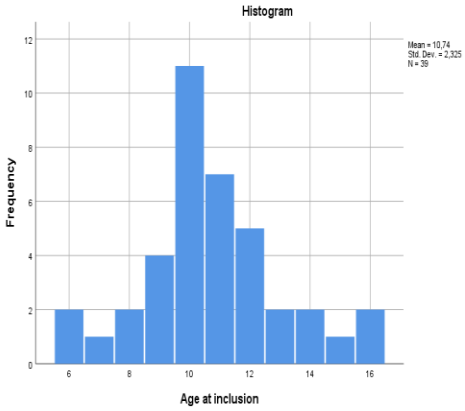


Figure 6 Distribution of scores total score ADHD-RS

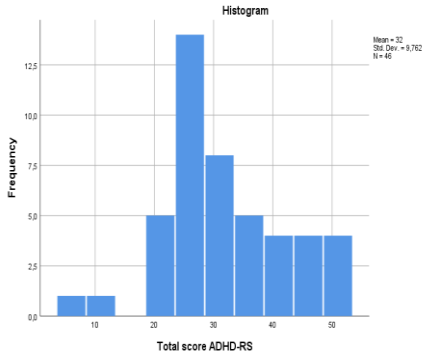


Table 2 Test of normality for the explanatory variables ADHD-RS, SDQ and WISC-IV

Variables	***Shapiro-Wilk test of normality***		
	Statistic	***df***	***p***
ADHD-RS			
Inattention	.977	46	.495
Hyperactivity/Impulsivity	.977	46	.476
Total score	.967	46	.212
WISC-IV			
Verbal Comprehension	.976	36	.624
Perceptual Reasoning	.977	36	.636
Working Memory	.948	36	.093
Processing Speed	.979	36	.708
Full Scale IQ	.976	36	.614
SDQ			
Prosocial Behaviour	.888	43	.001
Hyperactivity/Inattention	.937	43	.020
Emotional Symptoms	.925	43	.008
Conduct Problems	.918	43	.005
Peer Problems	.942	43	.032
Externalising Score	.960	43	.134
Internalizing Score	.945	43	.040
Impact Score	.960	43	.138
Total Score	.981	43	.701

3.1.2 Correlation/ collinearity

Correlation analysis was run between the dependent variable and all explanatory variables. The results from this analysis is presented in the table of collinearity (table 3). Multicollinearity analysis was conducted for the explanatory variables gender, age, full scale IQ, total score ADHD-RS and SDQ's total score and impact score using collinearity diagnostics in SPSS. Tolerance is higher than 0.2 for every score and Variance Inflation Factor (VIF) is therefore below 5, and no problematic multicollinearity is detected between the predictor variables. In addition, none of the scores in the multivariate regression analysis had r >0.7 as shown in the correlation table (table 3), indicating no multicollinearity.

3.1.3 Distribution of dependent and explanatory variables

Difference in mean scores between the ADHD group and the ADHD and language problem group for scores on WISC-IV, ADHD-RS and SDQ are presented graphically in figures 7-9. Descriptive statistics for the dependent variable (score on the language screening test) is shown for the total sample, each of the two genders and each of the two age groups and is summarized in table 4. For the explanatory variables (WISC-IV, ADHD-RS and SDQ), descriptive statistics are presented for the total sample and by language problems. Descriptive statistics for the explanatory variables are summarized in table 5.

Figure 7 Mean score on the WISC-IV test by language problems.

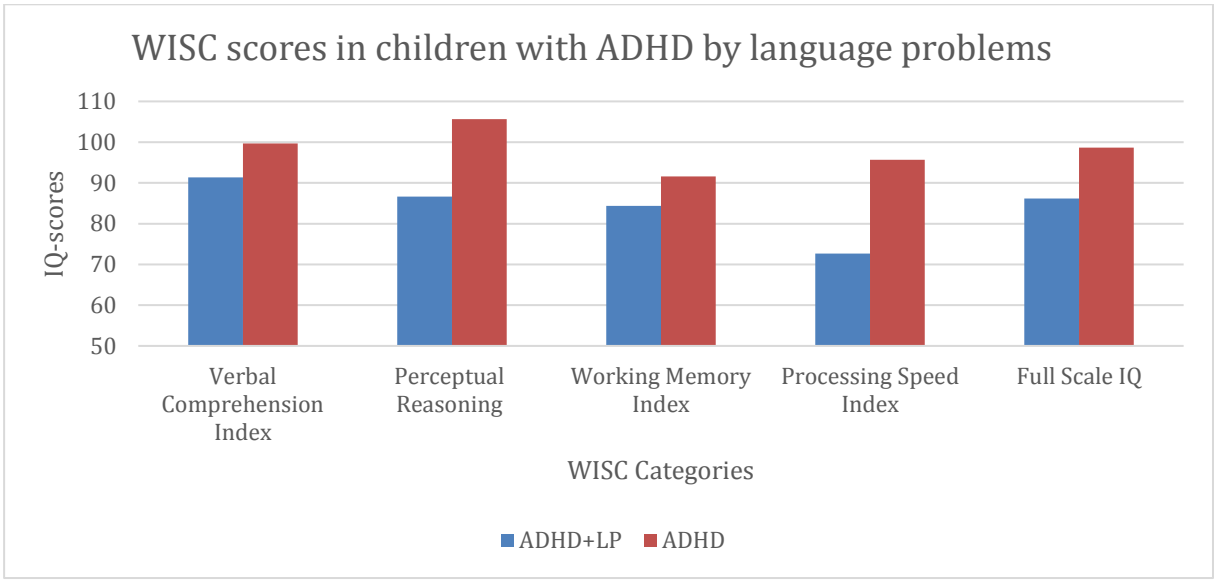


Figure 8 Mean score on the ADHD-RS by language problems.

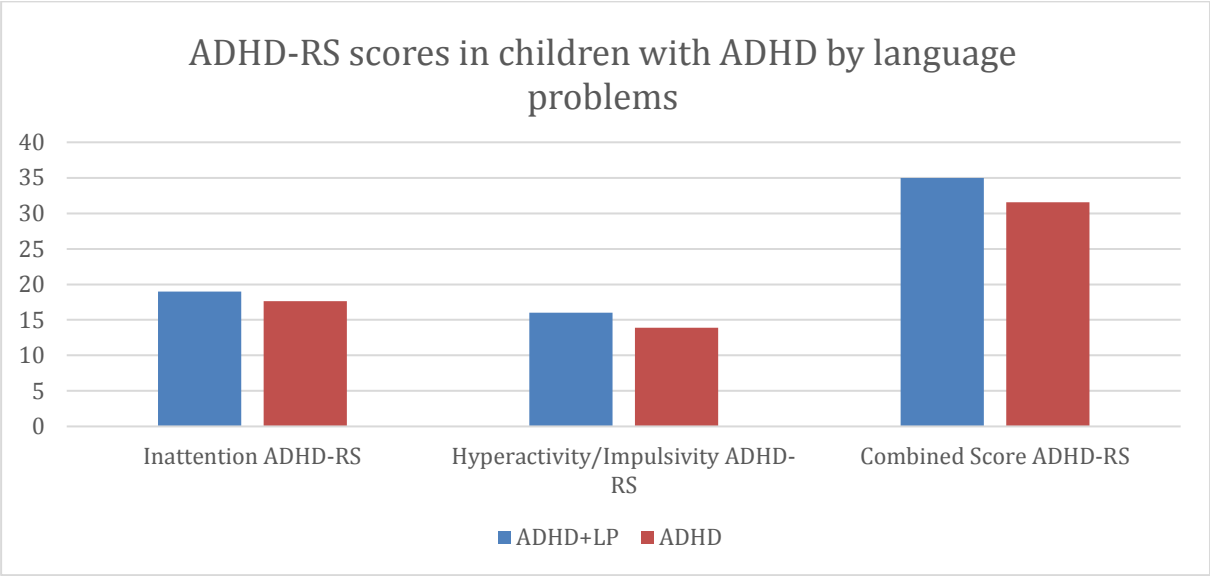


Figure 9 Mean scores on the SDQ by language problems. .

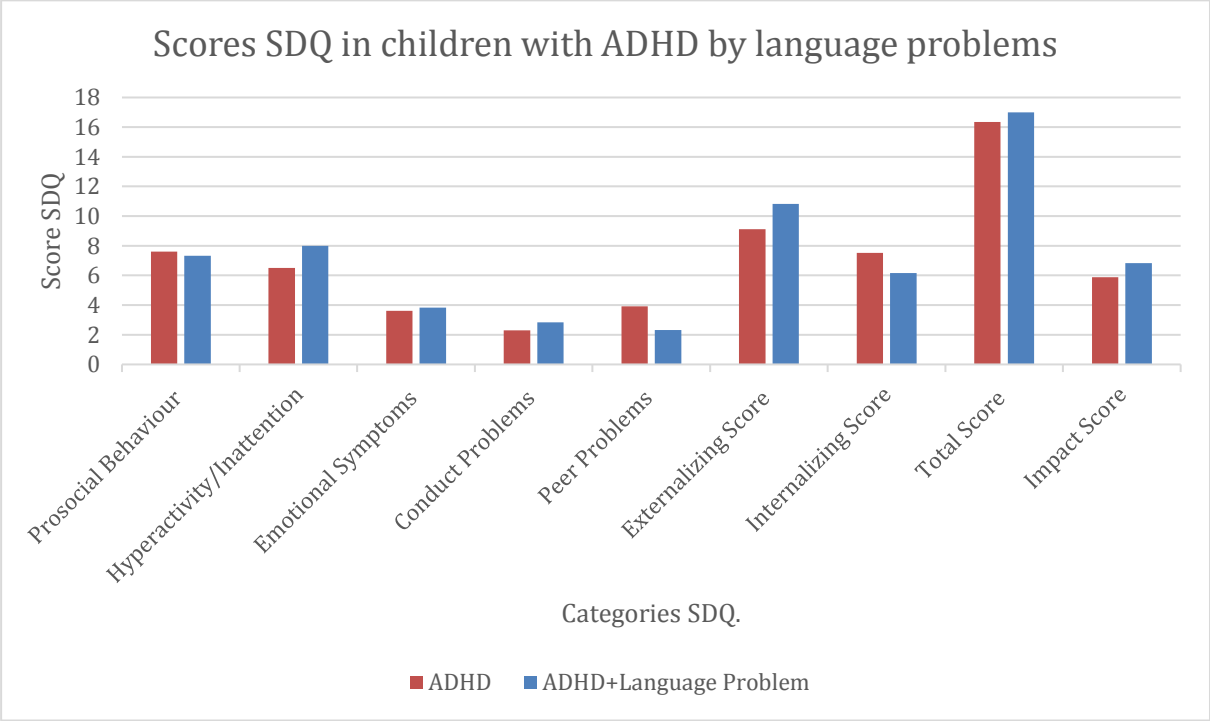


Table 4 Language problems for the total sample, by gender and by age groups.

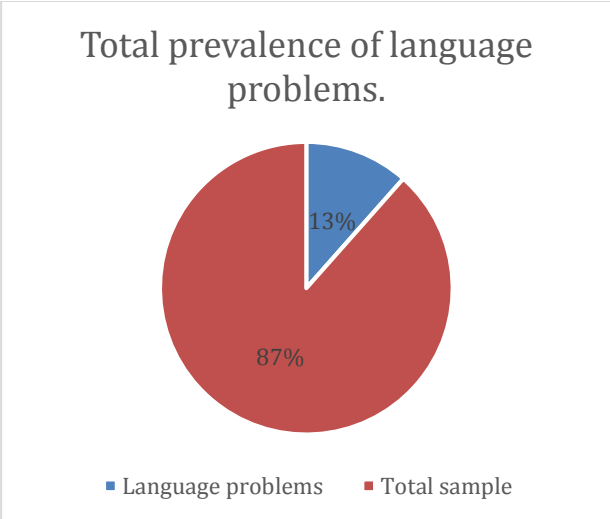
Group	***N***	***Min.***	***Max***	***M***	***SD***	***p***
Total sample	46	16	41	28.46	6.37	
Boys	29	17	41	27.97	6.57	.100
Girls	17	16	37	29.29	6.11	
Age 6-10	24	16	39	27.00	7.01	.022
Age 11-16	22	21	41	30.05	5.30	

3.2 Prevalence of language problems in children with ADHD

3.2.1 Total prevalence

Six of the 46 children in the sample had scores below reference level and was categorized as having a language problem. The total prevalence of language problems was 13.04 % (6/46). Prevalence is presented graphically in figure 10.

Figure 10 Prevalence of language problems in the total sample.



3.2.2 Prevalence of language problems by gender.

Four children had scores below the reference level among the boys, compared to two children among the girls. Prevalence of language problems in the female group was 2/17= 11,8%. Prevalence in of language problems in the male group was 4/29= 13,8 %. No significant difference in language problems was found between the two groups. Prevalence of language problems in the two groups is presented graphically in figures 11 and 12.

Figure 11 Prevalence of language problems in the male group

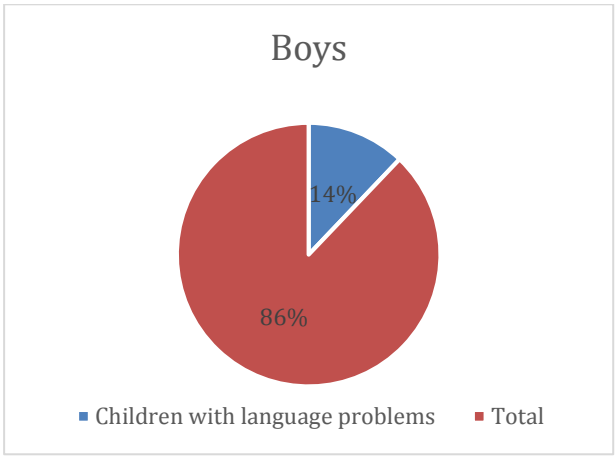
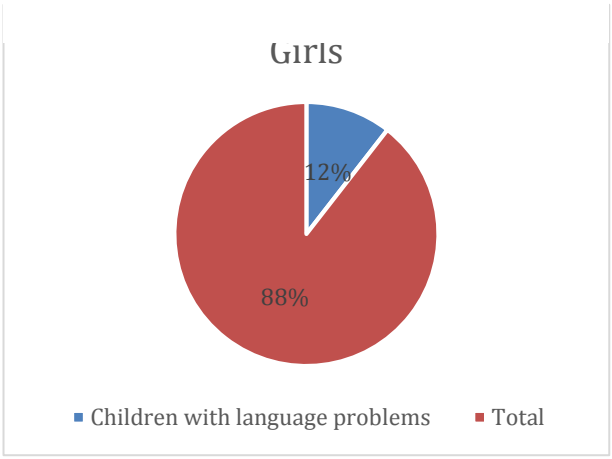


Figure 12 Prevalence of language problems in the female group.



3.2.3 Prevalence of language problems by age-group.

Six children had scores below the reference level in the age group 6-10, prevalence of language problems in this group was 6/24= 25%. None of the children in age group 11-16 had scores below reference level. A significant difference in prevalence of language problems was found between the two age groups. This finding however needs to be analysed with caution as there are no scores below the reference level in the age group 11-16, and significance usually is not calculated with less than five participants in one of the groups. Prevalence of language problems in the two groups is presented graphically in figure 13 and 14.

Figure 13 Prevalence of language problems in the age group 6-10 years

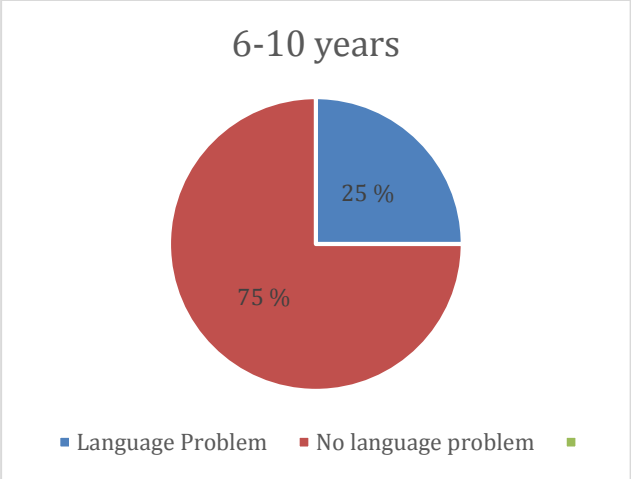
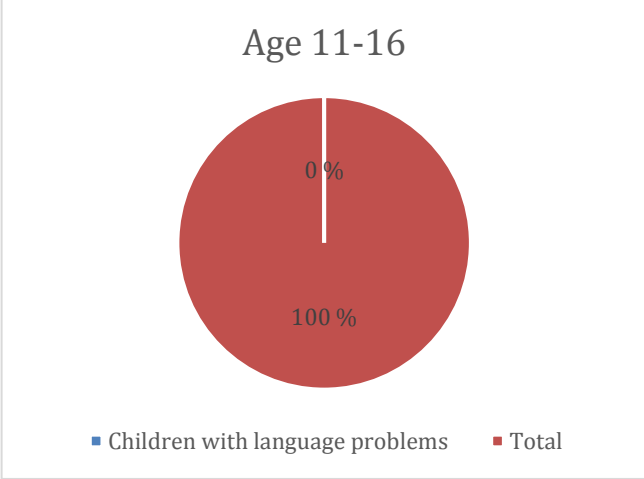


Figure 14 Prevalence of language problems in the age group 11-16 years



3.3 Associations between language problems and the explanatory variables.

3.3.1 IQ

A strong positive correlation was found between all scores on the WISC IV and score on the language screening test. All scores on the WISC-IV was statistically significantly correlated with score on the screening test for language problems. All results from the correlation analysis is shown in the correlation table (table 3). Linear regression analysis was conducted to further examine the associations between scores on the WISC-IV and language problem. This analysis found that only full scale IQ was a statistical significant predictor of score on the screening test for language problems, (R^2=.409, F(1, 34)=23.503, p < .001). The regression equation for predicting language problems from full scale IQ was ŷ= -4,298+0,344x.

The language problem group had significantly lower mean scores on the WISC-IV on perceptual reasoning, processing speed index and full scale IQ. Difference in scores for verbal comprehension index and working memory index did not reach statistical significance with (p > .05). Results from the t-test is summarized in table 5.

3.3.2 ADHD-symptoms and SDQ

Correlation between scores on the ADHD-RS and score on the screening test for language problems was weak, and p-value for the Pearson correlation was non- significant.

Correlation analysis for scores on the SDQ and score on the screening test for language

problems showed a weak negative correlation between these scores, but the correlation din not reach significance. Results from the correlation analysis is summarized in the correlation table (table 3).

No significant difference in mean score between children with ADHD and language problem and children without a language problem was found for any of the category of ADHD-RS or SDQ in the t-test. The results from the t-test is summarized in table 5.

3.3.3 Gender differences

Association between gender and language problems in children with ADHD is examined using a chi-square test. No statistically significant association was found between gender and language problems in this sample. The results from the chi-square test is summarized in table 6.

3.3.4 Age differences

Age at inclusion is positively correlated with score on the screening test for language problems r=0.300, p=.043). As shown in table 4, children in the age group 11-16 have higher mean scores on the screening test for language problems compared to children in the age group 6-10. In the chi-square test, a significant association between age and language problems was found This significance however must be analysed with caution as the number of children with language problems in the age group 11-16 was zero, and significance usually is not calculated with such a low number of in one of the groups. Note that the Fisher's Exact Test was used in this analysis. The Chi-square test is summarized in table 6.

Table 6 Chi-square table for age and gender by language problems

Variables	***ADHD***		***ADHD+ LP***		***p***
	N	***%***	***N***	***%***	
Age group					
6-10	18	75	6	25	.022*
11-16	22	100	0	0	
Gender					
Boys	25	86.2	4	13.8	.100^{NS}
Girls	15	88.2	2	11.8	

Note: Fisher's Exact Test is used for both gender and age due to the number of cells with expected count less than 5.

*p <.05. NS= Not significant

3.4 Multivariable regression analysis

For the binary logistic regression analysis the aim was to see how the explanatory variables are able to predict language problems in children with ADHD. In step 1, age was found to be a significant predictor of language problems when adjusting for gender. Gender was not found to be a statistical significant predictor of language problems when adjusted for age.

In step 2, full scale IQ was added to the model adjusted for the sociodemographic factors. Full scale IQ was found not to be a significant predictor of language problem in this analysis at 5 % significance level when adjusted for sociodemographic variables. Age was still a significant predictor when adjusting for gender and full scale IQ.

In step 3, variables concerning symptoms of ADHD and SDQ (total score ADHD-RS, total score SDQ and impact score SDQ) was added to the model. None of these variables was a statistical significant predictor of language problems in children with ADHD in this study. None of the other variables reached statistical significance in predicting language problems when adjusting for the variables concerning ADHD symptoms and SDQ.R^2 for the final model is suggesting that the predictor variables explains 72,7% of the variance in the dependent variable.. However, as noted, none of the predictor variables was significant in step 3 of the analysis, and the R^2 are therefore not reliable. Scores from the logistic regression analysis is summarized in Table 7.

Table 7 Logistic regression analysis examining the relationship between language problems, gender, age, full scale IQ, and ADHD symptoms in children with ADHD.

	Language problems	
Predictors	***OR***	***95% CI***
Step 1		
Gender	.464^{NS}	.044-4.940
Age	2.214$^{p=.023}$	1.115-4.396
R^2	.353	
Step 2		
Gender	.193^{NS}	.012-3.119
Age	2.219$^{P=.044}$	1.021-4.822
Full Scale IQ	1.130$^{NS\ (p=.081)}$	.985-1.295
R^2	.501	
Step 3		
Gender	.025^{NS}	.000-12.81
Age	3.925^{NS}	.611-25.226
Full Scale IQ	1.378^{NS}	.857-2.215
Total Score ADHD-RS	.718^{NS}	.425-1.214
Impact Score SDQ	1.030^{NS}	.304-3.493
Total Score SDQ	1.356^{NS}	.821-2.239
R^2	.727	
*p <0,05. NS= not significant		

4 Discussion

Prevalence of language problems in this study was 13,04%. The first hypothesis in this paper postulated that children with ADHD or ADD have a higher prevalence of language problems compared to children without a hyperkinetic disorder. As noted earlier, the prevalence of language problems are estimated to be about 5-10%(5) in normal children. Another study claims that specific developmental language deficits have a prevalence of 3-10% in pre-schoolers.(34). Odds ratio for language problems in children with ADHD are estimated to be 2,8, and children with ADHD have a threefold risk of having a concurrent language deficit (6, 7). The children in this survey have a diagnosis of either ADD or ADHD, and a prevalence of 13.04% suggests that there is a higher prevalence of language problems in children with ADD or ADHD compared to children without a similar diagnosis. A prevalence of 13.04% corresponds well with a threefold increased risk for language problem in this group as suggested earlier (7) if a prevalence of approximately 5% is assumed in the normal population. However, if a prevalence of language problems close to the highest prevalence of 10% is assumed in the normal population, a prevalence of 13,04% does not fit with the threefold increased risk or odds ratio of 2,8 described above. Expected prevalence in the ADHD group would then be approximately 30%. An estimation of prevalence of language impairment in the normal population between these two values would give an estimated prevalence between 15-30 %. With this in mind, the prevalence of language problems found in this study is somewhat lower than expected.

The second hypothesis in this study was that the prevalence of language problems in children with ADD or ADHD in this sample did not differ from the prevalence found in reliable studies in other countries. As shown in table 1, the prevalence of language problems found in other studies was approximately 40-45% in several of the studies (6-8, 11). Only the Danish retrospective register based study had a similar prevalence to what was found in this study of 15,4 % (10). There can be several reasons to why the prevalence in the current study differs from other studies. First, the children participating in this study are children who have got an ADD or ADHD diagnosis and are submitted to join the study by a psychiatrist or psychologist at the different child and adolescent's mental health clinics in

Norway. The aim of the original study from which this data is collected is to examine the effect of Omega-3 fatty acid supplements on ADHD-symptoms. It is possible that the children who are submitted to join this research project are children who experience mild to moderate symptoms of ADHD or ADD, and therefore find that they want to try out Omega-3 fatty acids before use of central stimulant medication. Reasons for this can be a negative attitude to medicinal treatment with a central stimulant drug. The child may also have experienced negative side effects from use of central stimulants, and therefore want to participate in the study. Another aspect is that the psychiatrics or psychologists that submit children to the study perhaps only submit children with less severe symptoms of ADHD or ADD because of a feeling of obligation to provide best medical treatment to children who are most severely affected by their ADHD or ADD. Any of these factors can contribute to a selection bias of children with only mild to moderate symptoms to the study.

Another explanation to the difference in prevalence of language problems is how a language problem is defined in the different studies, and how language problems are examined. Ideally, only studies using the same screening test for language function and with the same cut of values for language problems should be used to compare prevalence of language problems between regions or countries. In this study, the screening test “Språk 6-16” is used, and language problems is defined as scores below reference level on the three obligatory tests in the screening tool based on national norm data. In the studies mentioned in table 1, several different tests have been used to examine for language problems. In the Australian population-based study (7), language function was measured by using the Clinical Evaluation of Language Fundamentals, fourth edition, Screening Test (CELF-4 screener), a screening tool identifying children at risk of having language disorders. The test has a sensitivity and specificity of 0,88 and a test –retest reliability of r=0,89. Prevalence of language problems in children with ADHD was 42% in this study, 38% after excluding children with Autism Spectrum Disorder (ASD). However, the prevalence of language problems in the control group was 17%, far more than expected based on a prevalence of language problems of 5-10 % (5). This suggest that the test used in this study might be over estimating the prevalence of language problems in both groups. In the study from Israel(6), prevalence of language problems in children with ADHD are estimated to be 45%. In this

study, it is mentioned that usual standardized approach for language problems are associated with a high identification rate of false negative. The cut off for language problems used in the mentioned study is 1 SD below mean score. This is debated in the discussion as a non-conservative criteria for language problem, and therefore also might over estimates the prevalence of language problems. Even though these studies might give a high estimate of the prevalence of comorbid language problems, several other studies have shown similar prevalence, as shown in table 1. The lowest estimate was found in the Danish register based retrospective study (10), with a prevalence of 15,4 %.

Based on the discrepancy in the available studies, one can assume that the true prevalence of language problems in children with ADHD is probably somewhere between the prevalence presented in table 1. The prevalence found in this study of 13,04 % is therefore probably under reporting the prevalence of language problems in this group of patients. In the current study, only scores on three of the sub-tests in the language test was used. These three categories are described as a good tests for the child's verbal short time memory, its ability to organize and withhold information from sentences and the semantic aspect of language. The three categories not included in this study was grammar, phonological awareness and two tests scoring the child's reading ability. The sub category "Grammar" shows the child's knowledge about words and how to create correct sentences. The sub category "phonological awareness" is a test for the child's ability to discover small segments of sentences and the two categories "word decoding" and "reading rate" says something about the child's reading ability. One can imagine that some of the children who had a score in the lower reference level on the three obligatory tests in the language screening test might have had a score below reference level on one of the supplementary tests and therefore have a language problem that is not addressed in this study. The scores on the reading ability test are especially important as reading disability is a common comorbid diagnosis in children with ADHD, with prevalence of approximately 40% in some studies (35, 36).

The language screening test "Språk 6-16" used in this study is validated, and norm data for Norwegian children is available. The sensibility and sensitivity of the screening test is not

stated, and prevalence of language problems found using this test is therefore hard to compare with other studies where the sensitivity and specificity of the tests is known. The small sample size is also a factor that might contribute to the low prevalence of language problems found in this study. Lastly, another factor that possibly can have influenced the prevalence of language problems in this study is the fact that 50 % of the participants was receiving Omega- 3 capsules when testing for language function and the other tests. A meta-analysis published in 2011 concluded with a small, but significant effect of Omega-3-supplementation on ADHD symptoms(37). ADHD-symptoms measured as high scores in ADHD-RS and score of hyperactivity/inattention on the SDQ was not associated with language function in the analysis run in this study, and it is therefore not likely that it will have influenced the result on the language test significantly. It also needs to be mentioned that the tests used in this study are conducted very early in the 6 month follow up period when the children are taking Omega-3 or paraffin capsules. It is therefore not likely that this has influenced the language function of the participants in any way.

The third question raised in this study was whether the IQ was different between the ADHD/ADD group and in the ADHD/ADD and language problem group. The independent t-test between the language problem and non- language problem group was significant for scores on perceptual reasoning, processing speed and full scale IQ. This corresponds with another study (6) where IQ-measures was statistically significant different for the ADHD and language problem group compared to the group with only ADHD. The finding was however addressed as not clinically significant in the mentioned study.

Several studies have found changes in processing speed in children with ADHD similar to the findings in this study (38, 39). For perceptual reasoning, one study present findings opposite to the findings in this study, where children with ADHD show normal function of perceptual reasoning (40). As the linear regression with scores on the WISC-IV as predictors of score on the screening test for language problems done in this study suggests that only full scale IQ is a significant predictor of score on the screening test for language problems, only full scale IQ will be further discussed. An association between full scale IQ and language problems in children with ADHD may indicate that language problems is affected by the child's cognitive

abilities. A high score for full scale IQ is perhaps associated with a high language function and less language problems. This correlates with the results from a study on language problem and ADHD (41) where the language problem group have approximately ten points less on the score for performance IQ compared to the normal language group.

In addition to full scale IQ, several studies on children with ADHD have focused on the relationship between ADHD, language problems and working memory (42-44). In one study (43), the conclusion was that working memory deficits are not characteristic with ADHD, but are associated with language impairments. Another study (42) found that children with ADHD also had deficits in components of working memory regardless of comorbid language impairment. A meta-analysis on working memory in children with ADHD (44) concluded with deficits in working memory independent of comorbidity with language disorders or weaknesses in general intellectual ability. As described earlier, a similar finding was found in this study with a positive correlating between score on the language screening test and score for Working Memory. The score for Working Memory was not significantly different in the independent t- test with children with ADHD and children with ADHD and language problems as grouping variable, and the linear regression analysis was also not significant. This is probably due to the small sample size in this study, especially concerning the small number of participants in the language problem group.

The forth hypothesis postulated was that subtype of ADHD have a confounding role in language problems in children with ADHD/ADD. Type of ADHD was defined in this study by calculating scores for hyperactivity/impulsivity, inattention and total score using the ADHD-RS. Few studies examining the effects of the different subtypes of ADHD on language problems are conducted. In the Australian population-based study (7) the prevalence of language problems was highest in the combined group, with a percentage of 47%. Prevalence was 36% in the hyperactivity/impulsivity group and 33% in the inattention group. Another study found that symptoms of inattention predicted performance on verbal and visual spatial central executive functions, but symptoms of hyperactivity/impulsivity did not predict performance in the same categories in any way(42). A study examining the effect of hyperactivity and inattention on pragmatic language function found no difference between

the group with high levels of hyperactivity or in the group with poor attention compared to controls. There was however a difference in the group with high level of hyperactivity and poor attention (45). This correlates with the finds from the previous mentioned study that language function more frequently affected in children with a combined type of ADHD. The current study found no significant correlation between scores on the ADHD-RS and language function in any category. The only score which seemed to have a negative correlation, though not significant, was score for inattention. Total score on the ADHD-RS was not associated with a higher prevalence of language problems, and it is not possible from this study to say if one subtype of ADHD has a higher risk of experiencing language problems.

In this study, a total score on the ADHD-RS and a total score and impact score on the SDQ was calculated. If language problems are associated with the amount of ADHD-symptoms the child experiences, one would assume that the children with language problems in this sample would have high scores on these three tests. None of these tests however was significantly associated with language problems in this study. This suggests that ADHD-symptoms experienced and the impact on the child and its family is not determining for language problems in children with ADHD, and that something else holds a greater role in language problems in children with ADHD. The impact of ADHD-symptoms on language function cannot be disregarded after this study however, mostly because of the small sample size in both groups, but especially the language problem group. As noted previously in this section, studies examining the effect of ADHD-symptoms on language function in children with ADHD show great discrepancy, and more studies on this subject are needed to conclude answer these questions in the future.

Gender differences in language problems with ADHD was also of interest in this study. The percentage of girls in this sample was 37%, similar to percentage in other studies. We proclaimed that language problems were more common in girls with ADHD than in boys, as found in two previous studies (6, 19). As shown in the results in this study, there was a difference in mean score on the screening test for language problems between girls and boys. The male group had lower mean scores than the female group on the language screening test, suggesting that boys in this sample had a poorer language function compared

to the girls. The difference in mean scores was too small to reach significance in such a small sample, and therefore it is concluded that there is no difference in language problems between the sexes. This corresponds with a third study (7), which concluded with no gender differences in children with ADHD regarding language problems.

A meta-analysis (21)on the subject found that ADHD-girls showed lower levels of hyperactivity and inattention in a non-referred population, and no difference was found in clinical samples. Another study found similar traits with boys experiencing more combined and hyperactivity symptoms, and equal or less inattentive symptoms than girls (46). On the SDQ, we did not find any significant difference between the sexes in this study. Several studies have found that boys experience more externalizing problems than girls (20, 21, 47). The mentioned studies all find that girls experience more internalizing symptoms than boys, but a similar finding is not done in this study. All the above mentioned studies are large studies, and similar results might have been found with a larger sample size in this study.

For scores on the WISC/WPPSI, there was no statistical significant difference between the genders in this sample, even though girls scored higher than the boys in almost every category. This does not correspond with other studies where girls with ADHD often are found to have greater intellectual impairments than boys with ADHD (20, 21). As noted earlier, the children in this study might consist of a selected group with less symptoms of ADHD compared to children in other studies. This may be one of the reasons why the results in this study does not correspond with other studies. The available research on gender differences in ADHD are quite coherent when it comes to what type of symptoms the different genders experience and for cognitive profile for boys and girls with ADHD. For language problems and ADHD, the findings are not equally coherent, and more research on the area is needed to better understand gender differences in children with ADHD and language problems.

The final hypothesis in this study was regarding age differences in prevalence of language problems in children with ADHD. In this study, the postulation was that language problems increase with increasing age. The rationale behind this statement was the assumption that language becomes increasingly complex as the child increases in age, and the expectations

and demands towards language function increases for each school year. As the result shows, there was a significant difference in language problems between the two age groups, where more children in the age group 6-10 experienced language problems compared to the age group 11-16. In the result section, it is noted that this finding needs to be analysed with caution because of the fact that there is no participants with language problems in the age group 11-16, and significance is usually not calculated with a fewer than five participants in one of the groups. However, age was also a significant predictor of language problems in the binary logistic regression where age at inclusion as a scaled variable was the predictor of language problems. The test revealed that children in the younger age group experience more language problems, the opposite of what we had hypothesised in forehand. It is possible that the children in the younger age group experience more language problems because symptoms of ADHD are more prominent in this group. Selection bias can perhaps explain some of the observed results. It is possible that the 6-10 age group contains more children with a newly diagnosed ADHD who experience more symptoms of ADHD, but are reluctant to start medicinal treatment with a central stimulant drug, and therefore wants to participate in this study. The same perhaps can be said for the age group 11-16 which might consist of children who previously have used central stimulant medication, but whose symptoms have decreased and they therefore want to participate in this study to see if they can manage without medicinal treatment. Again, the small sample size of the language problem group is a limitation regarding the finds for this factor as well, and more research with larger sample sizes is needed to say with certainty that age is a correlating factor in language problems in children with ADHD.

4.1 Strengths and limitations

4.1.1 Strengths

- The children participating in this study has a certified ADHD or ADD diagnosis acquired after thorough examination according to national guidelines.
- Only a few clinics with personnel trained for this purpose are conducting the tests and examinations used in this study. This certifies that the test are conducted with a high quality and ensures the validity and reliability of the tests conducted. In

addition, the study uses information from teachers, parents and self-report questionnaires to get a broader evaluation of the child's clinical situation.

- Children from all over the country can apply to be part of the study, and the data can therefore be generalized as national data, and can say something about ADHD/ADD and language problems on a national basis. Children from all ethnicities in Norway are also able to participate in this study.
- The participants are not currently receiving any central stimulant medication or other ADHD/ADD medication of any kind, nor have they received ADHD/ADD medication one month prior to participating in this study. This allows the results of the language screening test and the other tests conducted to be interpreted without having to account for the effect of medicinal treatment.
- There are strict criteria of inclusion and exclusion present in the study to ensure that the participants represent the right sample of children without important comorbid diseases or factors that could influence the results.

4.1.2 Limitations

- The most prominent weakness of this study is the risk of selection bias of children with mild or moderate symptoms of ADHD/ADD to participate in the study. As noted earlier in the discussion, there is a risk of the participants consisting of a high proportion of children who either have not so severe symptoms or children/ children of parents who have negative thoughts or experience with medicinal treatment.
- The other distinct weakness with this study is the small sample size, especially the number of children with ADHD/ADD and language problems (N=6). With a sample size this small it is hard to reach statistical significance for an analysis despite apparent differences between groups. With a sample size this small, the analysis is very vulnerable for extreme values and values and errors in the dataset. It is also not possible to generalize and say that the results from this research can be transferred to account for all children with ADHD/ADD and language problems with a sample size this small.

- The fact that the sensitivity and the specificity of the screening test is not known is a weakness to the study as it makes it harder to interpret and compare the prevalence in this study to other studies.
- Another weakness also mentioned in the discussion is the possible impact of Omega-3 fatty acids on the different scores used in this test. As the design of the original study is a randomized controlled trial, and the randomization code is not yet released at the time of this article, it is not possible to know which participants who have received Omega-3 capsules and which who have received paraffin capsules. The possible effect of Omega-3 capsules is however mild and the time of exposure is so low that it is doubtful that it has had an impact on the result in any way.
- It is mentioned as one of the strengths of this study that participants from all over Norway can apply to be a part of the study, and no ethnicities are excluded from the study. However, ethnicity and regional affiliation of the subjects are not known in this article, and it is not possible to examine for regional and ethnic differences.

5 Conclusion

Language problems was present in 13.04 % of the children in this study. This is a lower prevalence than found in several other studies. Possible explanatory factors is differences in study population, different definitions of language problems and different sensitivity and specificity in the screening tools used to assess language problems in the different studies. The language problem group had significantly lower mean scores on the WISC-IV on perceptual reasoning, processing speed index and full scale IQ compared to the group with normal language function. Full Scale IQ was the only category of the WISC-IV that was a significant predictor of score on the screening test for language problems after conducting a linear regression analysis.

The children in the group with ADHD and comorbid language problems was significantly younger than the children in the non-language problem group (p =.23). Age was also a significant predictor of language problems in the binary logistic regression analysis when adjusting for gender and full scale IQ.

No gender difference was found in this study regarding language problems. Available research on gender differences in children with ADHD is quite coherent regarding type of symptoms experienced, cognitive function and profile of cognitive functions affected for the separate sexes. On gender differences in ADHD and language problems, the research is more inconsistent, and more research is needed on this area to get a better understanding of the subject

This study reveals that language problems in children with ADHD is a field where more research is needed to get a more correct picture of the prevalence in Norway as well as in other countries. Factors associated with language problems in children with ADHD, and the impact of comorbid language problems on the child's daily life on short and long term are both areas where further knowledge is needed in order to prevent academic failure, psychiatric illness and school dissatisfaction in this group of patients.

The data provided in the current study is an early interpretation of some of the tests conducted in the "test-battery "in the study «ADHD and nutrition: The influence of omega-3 on ADHD related symptoms» conducted at the University Hospital of North Norway. The study is open for inclusion up to 23.11.2021, and an estimated 300-350 participants are expected. As this is a national study with children from all over Norway with children from all ethnic groups partaking, it is a unique opportunity to investigate language problems in children with ADHD on a national level with a more robust foundation of patients than available in the current study.

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Figures and Tables

Table 5 Scores on ADHD-RS, SDQ, WISC-IV and age for the total sample and by language problems.

	Total sample			***Language problems***			***No language problems***			***t***	***p***
Variables	*No*	*Mean*	*SD*	*No*	*Mean*	*SD*	*No*	*Mean*	*SD*		
Full Scale IQ	39	97,03	11,12	5	86,20	8,871	34	98,62	10,600	-2.486	.018
Verbal Comprehension Index	38	99,00	11,44	3	91,33	6,351	35	99,66	11,593	-1.217	.231
Processing Speed Index	38	93,87	14,45	3	72,67	15,948	35	95,69	13,013	-2.900	.006
Perceptual Reasoning	38	104,16	15,46	3	86,67	6,028	35	105,66	15,125	-2.138	.039
Working Memory	37	91,00	12,57	3	84,33	13,796	34	91,59	12,512	-.957	.345
Prosocial Behaviour SDQ	44	7,57	2,084	6	7,33	3,011	38	7,61	1,953	-.294	.770
Hyperactivity Inattention SDQ	44	6,70	1,972	6	8,00	1,789	38	6,50	1,942	1.775	.083

Emotional symptoms SDQ	44	3,64	2,598	6	3,83	2,787	38	3,61	2,605	.198	.844
Conduct Problems SDQ	44	2,36	1,894	6	2,83	2,483	38	2,29	1,814	.649	.520
Peer problem SDQ	44	3,70	2,226	6	2,33	2,338	38	3,92	2,161	-1.656	.105
Impact score SDQ	44	6,02	1,798	6	6,83	1,602	38	5,89	1,813	1.194	.239
Internalizing score SDQ	44	9,35	3,352	6	6,17	4,446	38	7,53	3,554	-.843	.404
Externalizing Score SDQ	43	7,34	3,660	6	10,83	3,189	37	9,11	3,356	1.175	.247
Total score SDQ	44	16,43	5,205	6	17,00	7,348	38	16,34	4,912	.285	.777
Inattention ADHD-RS	46	17,83	5,347	6	19,00	2,449	40	17,65	5,655	.572	.570
Hyperactivity/ Impulsivity ADHD-RS	46	14,17	5,979	6	16,00	3,847	40	13,90	6,226	.799	.429
Total score ADHD-RS	46	32,00	9,762	6	35,00	5,797	40	31,55	10,200	.804	.426

Table 3 Correlation table.

		PSB SDQ	HI SDQ	ES SDQ	CP SDQ	PP SDQ	IS SDQ	TS SDQ	IN RS	HI RS	CO RS	VCI	PR	WM	PS	FS
PSB SDQ	Pearson Correlation	1	-.043	.125	-.301*	-.389**	-.252	-.229	.099	-.186	-.056	-.294	-.051	-.213	.254	-.026
	Significance (2-tailed)		.781	.419	.047	.009	.099	.135	.521	.228	.718	.082	.769	.219	.135	.877
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
HI SDQ	Pearson Correlation	-.043	1	.246	.160	-.057	.212	.536**	.376*	.586**	.561**	-.146	-.040	-.208	.172	-.145
	Significance (2-tailed)	.781		.107	.299	.711	.167	.000	.012	.000	.000	.397	.815	.230	.315	.393
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
ES SDQ	Pearson Correlation	.125	.246	1	.046	.146	.176	.672**	.346*	.302*	.374*	.069	.156	-.279	.195	-.001
	Significance (2-tailed)	.419	.107		.765	.345	.253	.000	.021	.047	.012	.688	.363	.104	.253	.996
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
CP SDQ	Pearson Correlation	-.301*	.160	.046	1	.291	.209	.581**	.168	.265	.252	-.440**	-.364*	-.359*	-.453**	-.583**

	Significance (2-tailed)	.047	.299	.765		.055	.173	.000	.276	.083	.099	.007	.029	.034	.006	.000
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
PP SDQ	Pearson Correlation	-.389**	-.057	.146	.291	1	.170	.579**	-.067	.224	.097	.088	.090	.006	-.132	-.096
	Significance (2-tailed)	.009	.711	.345	.055		.269	.000	.666	.143	.530	.611	.602	.972	.443	.573
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
IS SDQ	Pearson Correlation	-.252	.212	.176	.209	.170	1	.312*	.320*	.231	.317*	.311	.100	.344*	.083	.083
	Significance (2-tailed)	.099	.167	.253	.173	.269		.039	.034	.131	.036	.065	.561	.043	.632	.625
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
TS SDQ	Pearson Correlation	-.229	.536**	.672**	.581**	.579**	.312*	1	.346*	.564**	.531**	-.161	-.045	-.373*	-.065	-.329*
	Significance (2-tailed)	.135	.000	.000	.000	.000	.039		.021	.000	.000	.349	.793	.027	.708	.047
	N	44	44	44	44	44	44	44	44	44	44	36	36	35	36	37
IN RS	Pearson Correlation	.099	.376*	.346*	,168	-.067	.320*	.346*	1	.484**	.844**	.051	.021	-.051	.049	.058
	Significance (2-tailed)	.521	.012	.021	.276	.666	.034	.021		.001	.000	.760	.901	.766	.772	.724
	N	44	44	44	44	44	44	44	46	46	46	38	38	37	38	39

HI RS	Pearson Correlation	-.186	.586**	.302*	.265	.224	.231	.564**	.484**	1	.878**	.083	.016	.189	.265	.014
	Significance (2-tailed)	.228	.000	.047	.083	.143	.131	.000	.001		.000	.619	.923	.263	.108	.933
	N	44	44	44	44	44	44	44	46	46	46	38	38	37	38	39
CO RS	Pearson Correlation	-.056	.561**	.374*	.252	.097	.317*	.531**	.844**	.878**	1	.080	.022	.088	.192	.041
	Significance (2-tailed)	.718	.000	.012	.099	.530	.036	.000	.000	.000		.633	.898	.603	.249	.806
	N	44	44	44	44	44	44	44	46	46	46	38	38	37	38	39
VCI	Pearson Correlation	-.294	-.146	.069	-.440**	.088	.311	-.161	.051	.083	.080	1	.600**	.579**	.280	.806**
	Significance (2-tailed)	.082	.397	.688	.007	.611	.065	.349	.760	.619	.633		.000	.000	.089	.000
	N	36	36	36	36	36	36	36	38	38	38	38	38	37	38	36
PR	Pearson Correlation	-.051	-.040	.156	-.364*	.090	.100	-.045	.021	.016	.022	.600**	1	.348*	.320*	.777**
	Significance (2-tailed)	.769	.815	.363	.029	.602	.561	.793	.901	.923	.898	.000		.035	.050	.000
	N	36	36	36	36	36	36	36	38	38	38	38	38	37	38	36
WM	Pearson Correlation	-.213	-.208	-.279	-.359*	.006	.344*	-.373*	-.051	.189	.088	.579**	.348*	1	.371*	.709**
	Significance (2-tailed)	.219	.230	.104	.034	.972	.043	.027	.766	.263	.603	.000	.035		.024	.000

	N	35	35	35	35	35	35	35	37	37	37	37	37	37	37	36
PS	Pearson Correlation	.254	.172	.195	-.453**	-.132	.083	-.065	.049	.265	.192	.280	.320*	.371*	1	.555**
	Significance (2-tailed)	.135	.315	.253	.006	.443	.632	.708	.772	.108	.249	.089	.050	.024		.000
	N	36	36	36	36	36	36	36	38	38	38	38	38	37	38	36
FS	Pearson Correlation	-.026	-.145	-.001	-.583**	-.096	.083	-.329*	.058	.014	.041	.806**	.777**	.709**	.555**	1
	Significance (2-tailed)	.877	.393	.996	.000	.573	.625	.047	.724	.933	.806	.000	.000	.000	.000	
	N	37	37	37	37	37	37	37	39	39	39	36	36	36	36	39
ST	Pearson Correlation	-.122	-.131	-.164	-.176	.075	-.045	-.164	-.020	.105	.054	.520**	.562**	.527**	.413**	.611**
	Significance (2-tailed)	.429	.396	.286	.254	.628	.774	.286	.896	.486	.724	.001	.000	.001	.010	.000
	N	44	44	44	44	44	44	44	46	46	46	38	38	37	38	39

Note: SDQ: PSB= Pro social behaviour, HI=Hyperactivity/Inattention, ES=Emotional symptoms, CP= Conduct problems, PP= Peer problems, IS=Impact score, TS= Total score. ADHD-RS: IN=Inattention, HI=Hyperactivity/inattention, CO= Combined Score. WISC: VCI= Verbal comprehension index, PR=Perceptual reasoning, WM= Working Memory, PS= Processing Speed, FS= Full scale IQ. Language test: ST= Screening test.

*p <.01, ** p<.001

Vedlegg 1: VEILEDNINGSKONTRAKT FOR MASTEROPPGAVE MEDISIN

VED DET HELSEVITENSKAPELIGE FAKULTET

Kontrakten leveres Seksjon for utdanningstjenester, Det helsevitenskapelige fakultet.

1 STUDENTENS PERSONALIA

Etternavn: TORGERSEN
Fornavn: ØYSTEIN
Fødselsnummer (11 siffer): [redacted]3
Studieadresse: TOMASJORDES 59, LEIL. 304
Postnummer/-sted: 9024, TOMASJORDES
Telefon: 45082265

2 AVTALEPERIODE

Avtalen gjelder fra 06.09.17 til 01.06.19

3 VEILEDNING

Angi hovedveileder og biveileder(e). En av veilederne må være fast vitenskapelig ansatt ved Det helsevitenskapelige fakultet. Hvis veileder planlegger å ha forskningstermin i kontraktsperioden, skal studenten informeres om dette når prosjektbeskrivelsen utarbeides. Veileder er i samarbeid med enheten ansvarlig for å sikre studenten veiledning i hele kontraktsperioden.

Veileders navn og kontoradresse: Siv Kvernmo
Biveileders navn og kontoradresse:
Biveileders navn og kontoradresse:

Veileder skal ha forskningstermin i perioden:

Veilederen skal:
- gi råd om formulering og avgrensing av tema og problemstilling
- drøfte og vurdere hypoteser og metoder

1

Biveileder:

(Biveileder):

Student: Øystein Torgersen

6 Grade evaluation of articles.

Referanse: Sciberras E, Mueller KL, Efron D, Bisset M, Anderson V, Schilpzand EJ, et al. Language problems in children with ADHD: a community-based study. Pediatrics. 2014;133(5):793-800.			**Studiedesign: Kasus-kontroll** **Grade – kvalitet** Middels-/lav kvalitet.
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Formålet med studien var å undersøke prevalensen av språkvansker hos barn med ADHD sammenlignet med barn uten ADHD, og i tillegg se på hvordan språkvansker påvirket sosial og akademisk funksjon hos barn med ADHD. En ønsket også å se på bruk av språktjenester i de to gruppene. **Konklusjon** Barn med ADHD har høyere prevalens enn av språkvansker sammenlignet med barn i kontrollgruppen, og språkvansker hos barn med ADHD bidro til signifikant dårligere akademisk funksjon. **Land** Australia **År data innsamling** 2011-2015 2011: Screening og fordeling i case og kontrollgruppe. 2012-15: 3-årig oppfølgingsperiode med gjennomgående testing.	**Populasjon** Deltakerne i studien var en del av Cildrens attention project, en longitudinell populajsonsbasert studie på ADHD. Barn fra 43 ulike skoler i Melbourne Australia fikk tilbud om å bli inkludert i studien. Foreldre og lærere til barn i 2.klasse fikk tilbud om å gjennomføre Conners 3 ADHD index som screening for ADHD. Foreldrene rapporterte også om barnet hadde blitt diagnostisert med ADHD eller annen utviklings/medisinsk lidelse tidligere. Foreldrene gav også opplysninger om demografi. Kasusgruppen ble definert som score over/lik 75 persentil for gutter og over/lik 80 persentil for jenter på både foreldre og lærerdelen av screeningen, eller om barnet tidligere hadde blitt diagnostisert med ADHD. Kontrollgruppen ble definert som barn under 75 persentil for gutter og under 80 persentilen for jenter på enten foreldre eller lærerdelen av screeningen, samt ikke tidligere diagnostisert med ADHD. Hvert positiv screenet barn ble så randomisert matchet på kjønn og skole med et barn i kontrollgruppen. Eksklusjonskriterier for begge grupper var foreldre-rapportert tidligere intellektuell avvik, alvorlig medisinsk lidelse, genetisk sykdom, moderat/alvorlig nedsatt sanseevne eller nevrologisk problem. Barn av foreldre med for dårlig engelskkunnskap til å kunne gjennomføre screeningen ble også ekskludert. ADHD-status ble bekreftet ved bruk av diagnostisk intervju med barnets foreldre med validert skjema Diagnostic Intervju Schedule for Children, DISC IV. Muntlige språkferdigheter ble vurdert ved bruk av Clinical Evaluation of Language Fundamentals, CELF-4 screener. Akademiske ferdigheter ble vurdert ved å benytte Word Reading og Math Computation subtester fra Wide Range Achievement test 4. Akademisk kompetanse ble vurdert ved bruk av lærervurdert Academic competence scale. Sosial funksjon ble vurdert ved foreldre og lærerrapportert peer-problems og prosocial behaviour fra Strengts and Difficulties Questionnaire **Statistiske metoder** Logistisk og lineær regresjon justert for sosiodemografiske faktorer og komorbiditet hos det enkelte barn.	**Hovedfunn** -40 % av barna i ADHD gruppen hadde språkvansker (42% av gutene og g 40% av jentene) mot 17% i kontrollgruppen. Etter justering for konfunderende faktorer fant man at barn med ADHD hadde større sannsynlighet for å ha språkvansker, OR 2,8 med 95 % konfidensintervall på 1,5-5,1. Dette gir en P-verdi på 0,001, altså statistisk signifikant. Konfunderende variabler var ikke statistisk signifikant assosiert med språkvansker, og ADHD var i så måte eneste signifikante predikator for språkvansker. -Barn med ADHD og språkvansker hadde dårligere akademisk ferdigheter enn barn med ADHD. Effect size var -0,7 for word reading, -0,8 for math computation og -0,7 for akademisk funksjon. -Det var ingen bevis for at språkvansker påvirket sosial funksjon. -Bruk av språktjenester var 42% i ADHD gruppen og 16% i kontrollgruppen.	**Sjekkliste:** Formålet i studien er klart definert, og kasus kontrol designet er egnet for formålet. Deltakerne er rekruttert fra samme område i Melbourne, Victoria i samme tidsperiode (2011-2012) og undersøkerne er blindet for gruppetilhørighet. Diagnose er validert gjennom screeningtest for ADHD samt validerte lærer og foreldre-skjama som forsikrer at barnet har symptomer på ADHD på flere områder som kreves for diagnose etter internasjonal standard. Kontrollgruppen og casegruppen er rekruttert på samme måte ,og kontrollene har vært gjennom samme diagnostiske testing som case-gruppen og kommet ut negativ. Kontrollene og kasusgruppen er rekruttert fra samme område. Gjennomsittsalder 7,3 i begge grupper. Kjønn 69% G i case og 64% G i kontrollgruppen. Viktige konfunderende faktorer er tatt hensyn til i inklusjons og eksklusjonskriterier. Det er gjennomført frafallsanalyser i studien. -**Tror du på resultatene?** Resultatene samsvarer med andre studier. -**Kan resultatene overføres til praksis?** Ja, assosiasjon mellom språkvansker og akademisk funksjon. -**tøtter litteratruen resultatene?** Ja, det er flere studier som viser at barn med ADHD har økt risiko for også å ha språkvansker. **Styrker:** Lang oppfølgingstid, tar høyde for flere konfunderende faktorer enn tidligere studier, populasjonsstudie, streng identifisering av case og kontroll, representasjon av jenter og ulike subtyper ADHD. **Svakhet:** Screeningtest som ikke spesifiserer type språkvanske. Full utredning av språkvansker mangler. Lavere deltakerrate i kontrollgruppen enn i case-gruppen.

Referanse: Tirosh E, Cohen A. Language deficit with attention-deficit disorder: a prevalent comorbidity. J Child Neurol. 1998;13(10):493-7.			**Studiedesign: Kohortestudie** Grade – kvalitet: Moderat/lav kvalitet.
Formål	Materiale og metode	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Formålet med studien var å få svar på 4 hypoteser omkring barn med ADHD og språkvansker. 1. Barn med ADHD har høy prevalens av oppmerksomhetsvansker og språkvansker. 2.Denne assosiasjonen er ikke nødvendigvis avhengig av IQ 3.Barn med ADHD og språkvansker har en annen type oppførsel enn barn med kun ADHD. 4. Barn med ADHD og språkvansker har dårligere kotidshukommelse enn barn med kun ADHD. **Konklusjon** 1. 45% av barna med ADHD hadde også en språkvanske. 2. Full-scale IQ var signifikant lavere i ADHD og språkvansker gruppen. 3.Det ble vist forskjell i oppførsel mellom de to gruppene. 4. Barn med ADHD og språkvansker hadde statistisk signifikant dårligere kortitdshukommelse sammenlignet med ADHD-gruppen. **Land** Israel **År data innsamling** Oktober 1992-September 1993.	I Oktober 1992 ble lærere på 3 ulike skoler i 3 ulike sosiodemografiske områder i Haifa, Israel bedt om å finne barn med ADHD. Kun barn som oppfylte DSM-III-R kriteriene for ADHD var aktuell for å bli med i studien. 3208 barn mellom 6 og 11 år ble plukket ut, og av disse ble 166 (5,2 %) plukket ut av lærerne til å ha primært oppmerksomhetsvansker uten andre atferdsmessige komorbiditeter. Av de 166 var 27 allerede medikamentelt behandlet for ADHD. 5 av de sluttet på behandling og ble med i studien. I tillegg var det 24 hvor foreldrene ikke ønsket at barnet skulle delta. De 120 gjenværende ble intervjuet og vurdert. 19 ble funnet å ha komorbide lidelser eller manglende data, og derfor ekskludert. De resterende 101, 78 gutter (91%) og 23 jenter (9%) ble tatt med videre i studien. Ananlyser utført i oppgaven: 1. IQ-test, Weschler Intelligence test for Children. 2.Pediatrisk evaluering med fysisk og nevrologisk testing. 3.Oppmerksomhetstest: Parteus Maze test og Matching Familiar figures test. 4. Språktest som tester linket fonologisk prosessering, ekspressivt vokabular, setningsforståelse/syntaks og alderstilpasset leseferdighetstest. 5. Verbal og auditoriell hukommelse: Detroit test of learning Aptitude og Digit span test tatt fra Stanford Binet Intelligence test. 6.Test av tekstgjenkjennelse vha tidligere nevnte tester 7. Barnet ble vurdert av språkspesialist og kategorisert til språkproblem ja/nei. **Viktige konfunderende faktorer** Viktige konfunderende faktorer er annen komorbid atferdsforstyrrelse og er derfor brukt som eksklusjonskriterie. **Statistiske metode**: For normaldistribuerte data ble t-test benyttet.Chi-kvadrattest ble brukt for kategoriske data. IQ , verbal sekvensering og oppmerksomhetstest ble analysert med logistisk regresjonsanalyse med språkproblem ja/nei som avhengig variabel. Alle de 44x56 parene (et barn fra hver studiegruppe) ble sammenlignet. For å finne ut om mulig forskjell i oppførsel mellom de to gruppene ble ANSER-resultatene analysert med Pearson product moment correlation og resultatene ble sammenlignet. Statistical analysis system ble brukt til dataanalyse.	**Hovedfunn** **1.** 45% av deltakerne i studien ble identifisert til å ha minst 1 kompromittert språkfunksjon. I denne gruppen var den relative proporsjonen jenter signifikant større enn gutter (P.0,2) Weschler full scale IQ funnet til å være signifikant lavere i ADHD+språkvanske-gruppen sammenlignet med ADHD- gruppen 104,9, 6,1SD versus 107,6, SD 5,7. P= 0,02. Korttidshukommelse dårligere i ADHD+språkvansker sammenlignet med ADHD-gruppen. Verbal sekventiell hukommelse: 31/45 scorte 1SD eller mer under gjennomsnittet, mens 15/56 i ADHD gruppen gjorde det samme. P<0,001 Teksthukommelse også lavere, 25/45 vs 1/55 scoret 1SD eller lavere fra gjennomsnittet. P=0,001 Oppmerksomhetstest viste ingen signifikante forskjeller. Atferdskarakteriseringen av gutter med og uten språkvansker viste signifikante forskjeller mellom gruppene.	**Sjekkliste**: Det foreligger 4 klare hypoteser som studien ønsker å belyse. Gruppene er rekruttert fra 3 ulike skoler i 3 ulike demogrfiske områder i Haifa, Israel. Gruppene er sammenlignbare da de er selektert på samme måte. Det er påpekt at det er en forskjell i alder på gruppene, der ADHD+Språkvanskegruppen har snittalder på 9år, 1,4 SD mot 8,2 år 1,4 SD P=0,01 (seleksjons bias)*. Det er ikke beskrevet blinding i studien. **•Var de eksponerte individene representative for en definert befolkningsgruppe/populasjon?** Ja, representativ for israelske barn med ADHD og språkvansker og med bare ADHD. Eksposisjon ble målt likt i begge grupper. **•Ble mange nok personer i kohorten fulgt opp?** Alle deltakerne i studien gjort rede for, av 166 som ble inkludert etter eksklusjon var det 101 som gjennomførte studien. Frafallsanalyser er beskrevet. **Er det tatt hensyn til viktige konfunderende faktorer i design/ gjennomføring/analyser?** Ja, det er tatt hensyn til konfunderende variabler i eksklusjonskriterier, hvor andre atferdsforstyrrelser er vurdert til å ekskludere deltakere, da man spesifikt ønsket å se på barn med ADHD og språkvansker uten annen komorbiditet. Dette ble undersøkt i screeningen utført av lærerne i stadium 1 av studien. **•Tror du på resultatene?** Ja, analysene virker å være grundig utført og det stemmer overens med annen litteratur på området. **Kan resultatene overføres til den generelle befolkningen?** Nei, det er ikke overførbart til den generelle befolkningen da gruppene i studien er barn med ADHD og ADHD og språkvansker, samt fra samme by i Israel. **•Annen litteratur som styrker/svekker resultatene?** Forfattere viser i diskusjonsdelen til flere studier hvor en har lignende funn. **•Hva betyr resultatene for endring av praksis?** Resultatene forteller at man må ta hensyn til språkfunksjon når man utreder et barn for ADHD, da det er en svært prevalent komorbiditet. Den viser også at det er flere faktorer som spiller inn på språkvansker, blant annet IQ, kortidshukommelse, kjønn. **Styrke**: Funn som samsvarer med flere tidligere studier. **Svakhet**: Barn med andre atferdsforstyrrelser er ekskludert fra studien, og prevalens kan derfor overestimere eller underestimere prevalensen. Disproporsjonalt antall gutter ekskludert fra studien.

Referanse: Korrel H, Mueller KL, Silk T, Anderson V, Sciberras E. Research Review: Language problems in children with Attention-Deficit Hyperactivity Disorder - a systematic meta-analytic review. J Child Psychol Psychiatry. 2017;58(6):640-54.			**Studiedesign: Kasus-kontroll, metanalyse av case-kontroll studier.** **Grade – kvalitet** Moderat.
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Etablere hvilke typer språkvansker barn med ADHD opplever basert på en systematisk gjennomgang av litteraturen og bestemme det empiriske evidensgrunnlaget for språkvansker hos barn med ADHD sammenlignet med barn uten ADHD. **Konklusjon** Studien demonstrerer at barn med ADHD scorer dårligere på tester som måler gjennomgående, ekspressivt, reseptivt og pragmatisk språk sammenlignet med kontroller. Screeningundersøkelse for språkvansker burde derfor inngå i utredningen av ADHD. **Land** Systematisk gjennomgang av peer-rewied sudier publisert på engelsk. **År data innsamling** Studier fra 1980 til desember 2015 som oppfylte kriteriene ble tatt med i den systematiske analysen.	**METODE** Gjennomgangen ble gjennomført i tråd med foretrukne rapporterings verktøy for systematiske gjennomganger og meta-analyser (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). Databasene CINAHL, PsychINFO og Medline ble gjennomsøkt ved bruk av EBSCO host platform fra 1980 til desember 2015. Søket ble limitert til å omfatte fagfellevurderte studier publisert på engelsk. Søkestrategien brukte en kombinasjon av Medical Subject Headings terms for hver database. Sekundære referanser ble også undersøkt, og artiklene ble vurdert av to uavhengige forskere. Deltakerne i studien måtte ha symptomer på eller en fullstendig ADHD diagnose etter tidligere eller gjeldende diagnostiske kriterier i DSM (American Psychiatric Association, 2013) eller ICD International Classification of Disease (ICD; World Health Organization, 1992). Diagnosen kan ha blitt vurdert ved hjelp av strukturert eller semistrukturert diagnostisk intervju og eller ved at deltakeren scoret over terskelnivå på et validert kartleggingsverktøy for ADHD, som for eksempel ADHD rating scale. Kartleggingsverktøyet må foreligge i hjemmemiljø og i skolesetting, utfylt av hhv foreldre og lærere. Et slikt kartleggingsverktøy uten noen form for validering var ikke tilstrekkelig for inkludering i studien. Vurdering av språkfunksjon ble begrenset til standardiserte /validerte mål på viktige språkmodaliteter. **Statistiske metoder** Dataene ble analysert ved bruk av Stata 14 (StataCorp, College Station, TX). To utvalgs t-tests ble utført for å sammenligne ADHD og non-ADHD kontrollgruppen på språkvariablene ved bruk av gjennomsnitt, standardavvik, størrelse med $p < 0,05$ og 95% konfidensintervall. For den systematiske gjennomgangen ble alle relevante utfallsmål analysert og Pearsons r (r) og effect size (ES) ble kalkulert. Målingene ble kategorisert i henhold til hvilket aspekt av språket de utredet. Målingene falt inn i fire klare kategorier, gjennomgående, ekspressivt, reseptivt og pragmatisk språkfunksjon. En ytterligere kategori ble opprettet for å fange opp målinger som ikke falt inn i en av de fire hovedkategoriene.	Aldersspenn: 3–14 år median alder: 7–11 Omtrent 77% av alle med ADHD var gutter (n = 932). Sammenligning av språkfunksjon med og uten ADHD var hovedfokus i 17 (81%) av studiene. **Hovedfunn** 21 studier ble inkludert i den systematiske gjennomgangen (ADHD = 1,209; Control = 1,101), hvorav 60 av 68 separate analyser fant signifikante ($p < .05$) forskjeller mellom ADHD og kontrollgruppen i forhold til variabler på språkfunksjon. Oppfølgende metaanalyser fant evidens for store avvik i ADHD-gruppene for gjennomgående avvik, (10/11 studier $p < .05$; vektet gjennomsnittlig ES [WMES]: 1.04); ekspressive (10/10 $p < .05$; WMES: 1.23); reseptive (12/14 $p < .05$; WMES: 0.97), og pragmatisk språkfunksjon (4/4 studies $p < .05$; WMES: 0.98) sammenlignet med kontroller.	**Sjekkliste:** Formålet i studien er klart formulert. Studien er en meta analyse av casus-kontroll studier. Kriterier for inkludering i metaanalysen beskrives i detalj under materiale og metode. **Forskjeller kasus/kontroll-gruppe?** Variasjon i kasus kontroll grupper mellom de 21 studiene i metanalysen vil naturlig forekomme. Større andel gutter i case-gruppene sammenlignet med kontroll-gruppen for alle språkkategorier. Det er tatt hensyn til konfunderende faktorer i studien. **Tror du på resultatene?** Ja, denne metaanalysen bekrefter tidligere studiers funn om at barn med ADHD har større sannsynlighet for å ha språkvansker sammenlignet med barn uten ADHD og felles nevrobiologisk etiologi foreslås som forklaring. I tillegg konsensus mellom alle de inkluderte studiene i metaanalysen tyder også på at resultatet er reelt. Studien anbefaler grundig språkutredning av barn med ADHD.. **Styrke:** Ingen med IQ under 70 inkludert i studien. Inkluderer samfunnsbaserte kasus og kliniske kasusgrupper, dette gjør at begge sub-grupper representeres. Første studie som systematisk gjennomgår språkvansker hos barn med ADHD sammenlignet med barn uten ADHD. **Svakhet:** Bred definisjon av språkvansker for å inkludere flest mulig relevante studier. Ikke konsensus omkring begrep som spesifikk språkvanske, kan snevre inn antallet studier. Kun 6 av 21 studier sammenlignet ADHD og ADHD+språkvansker, kan tyde på dårligere språkfunksjon uavhengig av diagnostisert språkvanske eller ikke. Manglende forskning på etiologi. Mulig svakere resultat på grunn av samtidig redusert arbeidshukommelse eller eksekutiv funksjon eller del av global utviklingsforstyrrelse.IQ kan ha påvirket, ikke studert i denne studien. Ettersom studien krever standardiserte tester ekskluderes en del studier med annet design. Denne metaanalysen kan derfor underestimere språkvansker hos barn med ADHD. Tar med studier på klinisk-baserte kasusgrupper og samfunnsbaserte kasusgrupper. De kliniske kasusgruppene har ofte mer uttalte symptomer, og generaliserbarheten kan derfor gå ned.

Referanse: Helland WA, Helland T, Heimann M. Language Profiles and Mental Health Problems in Children With Specific Language Impairment and Children With ADHD. J Atten Disord. 2014;18(3):226-35.			**Studiedesign: Tverrsnittsstudie med flere grupper.** **Grade – kvalitet** | Lav
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Undersøke hvorvidt barn med spesifikke språkvansker og barn med ADHD kan skilles fra hverandre med tanke på språkprofiler, og også undersøke om disse to kliniske gruppene er forskjellige med tanke på problemer med mental helse **Konklusjon** Studien konkluderer med at språkfunksjon burde bli vurdert hos barn med ADHD og utredningsverktøy sensitiv for ADHD burde inkluderes når en vurderer barn med spesifikke språkvansker Mental helse burde vurderes i begge grupper. **Land** Norge **År data innsamling** Kommer ikke klart fram av artikkel, men artikkel publisert 2014.	**Populasjon** Studien består av 3 ulike grupper av barn mellom 6 og 12 år. En gruppe med spesifikke språkvansker, en gruppe med ADHD og en gruppe med typisk utvikling (friske kontroller). Tilsammen 59 deltakere i studien. Spesifikk-språkvanskegruppen består av 19 barn, gjennomsnittsalder 8,7 år, 17 gutter og 2 jenter. Deltakerne hentet fra register for språkvansker og inklusjons/eksklusjonskriterier: Klinisk diagnose satt av spesialist, ingen mental retardasjon, norsk som 1.språk, ingen sensorinevronalt hørseltap, snakker i setninger og fullførte CCC2-skjemaet. ADHD-gruppen: 21 barn, gjennomsnittsalder 10,1, 17 gutter og 4 jenter. Inklusjonskriterier/eksklusjonskriterier: ADHD diagnose rapportert av foreldre, ingen mental retardasjon, norsk som 1.språk, ingen sensorinevronal hørselstap, kunne snakke i setninger, fullført skjemaer.Typically-developing-gruppen: 19 barn, samme gjennomsnittsalder og jenteandel som SLI-gruppen.Inklusjon/eksklusjon: Ingen kjent lærevanske eller behov for spesialoppfølging fra skole: Ingen lese eller skrivevansker rapportert av foreldre. **Statistiske metoder** For CCC-2 gruppen ble forskjeller analysert vha enveis variansanalyse (oneway analysis of variance (ANOVA) med grupper (tre lag). Mellomfaktoriell og post hoc sammenligning ble gjennomført vha Tukey's honestly significant difference(HSD) test For SDQ ble forskjeller mellom gruppene testet non-parametrisk vha Mann–Whitney U test ettersom distribusjon av scorer ikke var normalfordelt i gruppene. Testene var to-halet med alphanivå på 0.05 .Statistiske analyser ble gjennomført ved bruk av SPSS versjon 18.0. Vedrørende utregning av effect size oppgis $\eta 2$ ved sammenligning av de tre gruppene (CC2) og Cohen's d oppgis når to grupper sammenlignes (SDQ)	**Hovedfunn** **Hvor stor er effekten?** -80,9 % av barn i ADHD gruppen hadde kommunikasjonsvansker basert på GCC, mens det var 78,9% i språkvanskegruppen. I typically developing gruppen var det 10,5 % som hadde kommunikasjonsvansker. -SIDC= Sosial Interaction Deviance Composite= I ADHD-gruppen var det 57,1 % med pragmatisk vanske mot 5,3% i SLI gruppen og 10,5 % i TD-gruppen. -Ingen forskjell mellom ADHD og TD gruppen for score som måler det strukturelle aspektet av språk, SLI sigifikant svakere. -ADHD-gruppen scorer høyere på interests-skala enn SLI og TD gruppen. ADHD-gruppen skilte seg signifikant fra SLI-gruppen i alle kategorier, samt den samlede score for SDQ -Emotonal symptoms: d=0,93, p<0,05 Hyperactivity-inattention= d=1,45, p<0,01 Total difficulties: d=1,25, p<0,01, Impact: d=0,81, p<0,05, Conduct problems: d=0,56, p<0,05, Peer problems: d=0,70, p<0,05, Pro-social behaviour: d= -0,23, ikke signifikant. Når en ser på frekvens av barn som scorer abnormalt i ADHD-gruppen og i SLI gruppen er forskjellene ikke signifikante for peer-problems, prosocial-behaviour og conduct problems.	**Sjekkliste:** Formålet med studien er ikke klart formulert da det ikke kommer fram av abstraktet at man i tillegg til å sammenligne ADHD og spesifikke språkvansker også skal sammenligne med normalt utviklede barn. Studien er ikke et typisk-case kontroll studie da det ikke foreligger noen studie av risikofaktorer Studien er mer en tverrsnittstudie som sammenligner to pasientgrupper. Språkvanskegruppen har fått diagnose av spesialist, mens ADHD-gruppen kun er rapportert av foreldre. Diagnosen ADHD krever at man har vist symptomer på ADHD på flere arenaer (eks hjemme og skole) og bør være bekreftet ved bruk av standardiserte utredningsverktøy. Diagnosen er således ikke validert. Kontroller er rekruttert fra frisk befolkning, men også kun basert på foreldreutsagn, kan dermed ikke utelukke at kontrollgruppen er fri for aktuelle sykdom. Gruppene er sammenlignbare i alder og kjønn, samt rekruttert fra samme område og samme kartleggingsverktøy er benyttet på begge gruppene. Inklusjonskriterer og eksklusjonskriterier sikrer unngår påvirkning av konfunderende faktorer. Det framkommer ingen klar frafallsanalyse. Studien er ikke blindet for utfall. Resultatene i studien samsvarer med andre lignende studier, og konkluderer som tidligere studier at barn med ADHD burde utredes for språkvansker. **Styrke:** Alle deltakerne kom fra rurale strøk i Vest-Norge , og på grunn av lite sosioøkonomiske forskjeller i den norske befolkning kan det antas at dette ikke har påvirket resultatene.Alle barna med språkvansker har fått diagnose av spesialist og hentet fra nasjonalt senter–>styrker muligheten for at alle faktisk hadde språkvansker.**Svakhet:** -Kun basert på foreldreutsagn, ingen objektive mål. -Forelderen kan ha språkvansker slik som barna, og dermed ha vanskelig for å fylle ut spørreskjema. - ADHD-diagnosen kun basert å foreldre. -Ingen mål på barnas kognitive ferdigheter -Ingen gullstandard for utredning av språkvansker, kan ha variert fra barn til barn. -En skulle forvente at alle i språkvanskegruppen fikk utslag på CCC-2 skjemaet, men kun 4/5 gjorde det.Lite antall deltakere.Mulig seleksjonsbias mtp ADHD-gruppen da så mange viste kommunikasjonsvansker.

Referanse: Jensen CM, Steinhausen H-C. Comorbid mental disorders in children and adolescents with attention-deficit/hyperactivity disorder in a large nationwide study. ADHD Attention Deficit and Hyperactivity Disorders. 2015;7(1):27-38.			**Studiedesign: Registerbasert tverrsnittsstudie** Grade - kvalitet: Middels/ lav kvalitet.
Formål	Materiale og metode	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Identifisere alle komorbide psykiske lidelser til barn diagnostisert med ADHD ved danske sykehus fra 1995 til 2010 **Konklusjon** Studien gir viktig informasjon om komorbide lidelser ved ADHD. Studien gir også verdifull informasjon om alder og kjønns påvirkning på komorbide lidelser ved ADHD. -Alder og kjønn, samt type komorbide lidelser kan kanskje brukes som risikomarkør for senere utvikling av komorbid lidelse. Effekten av de ulike lidelsene som risikomarkør for annen komorbid lidelse bør undersøkes ved langsiktige studier. **Land** Danmark **År data innsamling** 1995-2010	**Populasjon:** Alle barn mellom 4 og 18 år diagnostisert ved danske psykiatriske sykehus mellom 1995 og 2010. 14825 pasienter ble inkludert i studien. **Hoved utfall:** Alle førstegangsdiagnostiserte med hyperaktivitets lidelse (Hyperactivity disorders) F90-F90.9 ved danske psykiatriske sykehus mellom 1995 og 2010 ble inkludert i studien. Data ble hentet fra Danish Psychiatric Central Research Registry (DPCRR). I danske psykiatriske sykehus blir alle barn henvist for HD eller ADHD undersøkt multiple ganger i multidisiplinære team før diagnose blir satt. De fleste barna gjennomgår flere psykologiske tester og somatisk undersøkelse, samt undersøkt i naturlig miljø og rapporteringsskjema fra foreldre og lærere benyttes. Komorbid lidelse ble i studien definert som lidelser registrert inntil 3mnd før og etter første kontakt som ledet til diagnose med ADHD. **Viktige konfunderende faktorer** Kjønn og alder ved diagnose ble studert som konfunderende faktorer. **Statistiske metoder** Deskriptive statistiske analyser og Mann-Whitney U-test, uavhengige t-tester og kji-kvadrat-test ble brukt til å analysere data	**Hovedfunn** Totalt hadde 48% ingen av de undersøkte komorbide lidelsene , mens 52% hadde minst en av de undersøkte lidelsene. 26,2 % hadde to eller flere komorbide lidelser. De mest prevalente komorbide lidelsene var: -Atferdsforstyrrelse (disorders of conduct)16,5 % -Spesifikke utviklingsforstyrrelse i språk, læring og motorikk (15,4%) -Autismespektrum-lidelse (12,4%) -Intellektuelle avvik (7,9%) Mannlig kjønn assosiert med økt risiko for komorbid autismespektrumlidelser, atferdsforstyrrelser, tics og spesifikke utviklingsforstyrrelser. Kvinnelig kjønn assosiert med økt risiko for komorbid affektive lidelser, angstlidelser og spiseforstyrrelser.	**Sjekkliste:** -**Formålet klart formulert?** Ja, formålet er klart definert i 3 hypoteser/spørsmål som studien ønsker å besvare. -**Er gruppene rekruttert fra samme populasjon/befolkningsgruppe?** Alle de 14825 deltakerne er hentet i fra Dansih Psychiatric Central Research Registry. -**Var gruppene sammenliknbare i forhold til viktige bakgrunnsfaktorer?** Studiet baseres på register for psykiske lidelser. Alle deltakere er fra danske statsborgere mellom 4 og 18 år som har fått diagnosen ADHD mellom 1995 og 2010. Andre bakgrunnsopplysninger enn alder, kjønn og registrerte diagnoser 3 mnd før og 3 mnd etter møtet med helsevesenet som førte til ADHD diagnose er ikke nevnt i studien. -**Var de eksponerte individene representative for en definert befolkningsgruppe/populasjon?*** Ja, se punkt ovenfor. -**Ble eksposisjon og utfall målt likt og pålitelig (validert) i de to gruppene?** Data hentet fra register for psykiske lidelser. Om de ulike pasienten er utsatt for samme eksponering og om veien til diagnose er lik ved alle diagnostiske enheter i Danmark over de 15 årene dataene kommer fra er uvisst og problematiseres ikke i studien. -**Var studien prospektiv?** Nei, registerstudie der man så på psykiatriske diagnoser 3 mnd før og etter ADHD diagnose ble satt.. -**Er det tatt hensyn til viktige konfunderende faktorer i design/ gjennomføring/analyser?** Ja, en del konfunderende faktorer som alder og kjønn er analysert, og det er også kjørt assosiasjonsanalyser mellom de ulike komorbide psykiske lidelsene. **Tror du på resultatene?** Ja, men studien viser noe lavere prevalens av komorbide lidelser en rekke mindre studier med andre design (prospektive studier). Dette er problematisert i diskusjonsdelen i oppgaven. -Kan resultatene overføres til den generelle befolkningen? Nei, men kan antas å gjelde også for norske barn med ADHD da Danmark og Norge er lik i fht sosioøkonomisk status og psykiatripraksis. -**Annen litteratur som styrker/svekker resultatene?** Som tidligere nevnt noe lavere prevalens av komorbide lidelser påvist ved denne studien sammenlignet med andre studier. Mange av de andre studiene er mindre og med annen design. -**Hva betyr resultatene for endring av praksis?** Forteller at barn med ADHD har høy grad av komorbide lidelser, samt at enkelte barn kan ha multiple komorbide psykiske lidelser og derfor burde utredes nøye. -**Styrke** --Stort antall deltakere fra begge kjønn hentet fra kvalitetsregister. --Bredt fokus på alle kliniske relevante lidelser som finnes ved ADHD. --Fokus på hvordan de ulike komorbide lidelsene spiller inn på hverandre. -**Svakhet** --Kun 6 mnd deteksjonsvindu for komorbiditet, mulig for lite tid for å fange opp all komorbiditet --Alderen ved første ADHD-diagnose kan være så lav at noen av komorbide lidelser ikke er utviklet enda --Ingen eksklusjon av deltakere med intellektuelle avvik eller autismespektrum-lidelse gjør at resultatene ikke kan sammenlignes med studier som ekskluderer disse deltakerne. --Ikke bruk av standardiserte diagnostiske intervju ved diagnostisering av ADHD. -Mulig referral bias ved at det kan være barn med ADHD som ikke har alvorlige nok symptomer til å bli utredet.