

Exploring the occurrences of, and temporal relationships between, the negative life events, positive parenting, and externalizing and internalizing symptoms in Norwegian adolescents with ADHD:
Comparisons with general population and a matched control group

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Abstract

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Thesis title: Exploring the occurrences of, and temporal relationships between, the negative life events, parenting, and externalizing and internalizing symptoms in Norwegian adolescents with ADHD: Comparisons with general population and a matched control group.

Background: Research shows that, compared to their peers, adolescents with hyperkinetic disorder (ADHD) experience more negative life events (NLE), less positive parenting, and greater externalizing and internalizing symptoms. However, these findings predominantly stem from comparisons with large general population samples, not the demographically matched, smaller, and clinically relevant samples. The first aim of the current thesis was to explore whether such findings remain consistent across these two analytical approaches. Further, conduct and depression symptoms are frequently comorbid with ADHD, and in the general population these symptoms are mutually influencing and influenced by NLE and parenting. The second aim of this thesis was therefore to explore whether ADHD has a unique effect on the interplay between comorbid symptoms and the occurrence of NLE and positive parenting over time.

Method: Longitudinal data from 3,512 (self-reported ADHD: 87) Norwegian 8-10th graders recruited as part of the Monitoring Young Lifestyle study (Brunborg et al., 2019) was used. Adolescents were recruited through their middle schools following parental consent and completed questionnaires annually; only data from T1 (2017) and T2 (2018) were used. To address the first aim, the occurrences of NLE, positive parenting, externalizing, and internalizing symptoms were calculated, and associations between these characteristics and ADHD in the full sample were estimated using regression analyses. A control group was then extracted using pair-matching to the ADHD participants on 6 socio-demographic and health covariates. The ADHD- and matched control group were compared on occurrence of NLE, parenting style, and comorbid symptoms using paired samples t-tests. Finally, to address the second aim, path analysis and cross-lagged panel models were used to compare temporal relationships between NLE, parenting style, and comorbid symptoms between the ADHD and the matched control groups.

Results: Across comparison methods, adolescents with ADHD reported significantly more NLE in life history, and less positive parenting, greater externalizing, and internalizing symptoms at T1. At T2 differences in NLE and conduct remained for general population comparisons, but no differences remained for matched control comparisons. Cross-lagged panel models showed better fit when all examined associations between NLE, parenting, internalizing, and externalizing symptoms were estimated as unconstrained multi-group models, documenting a set of complex differences in temporal relationships amongst these constructs between ADHD - and matched control group. The differences primarily reflected high instability in parenting and life events among ADHD adolescents, as well as differences concerning the role of NLE life history and T1 parenting in this group.

Conclusion: Differences between adolescents with ADHD and their peers seemed exacerbated in the results from comparisons with the larger population sample (vs. a matched control group). Still, findings suggest a real set of challenges faced by the adolescents with ADHD. There was a significant difference in the cross-lagged panels between the ADHD and the matched control group, such that the examined 1-year period in ADHD group was marked by greater parenting and life events instabilities. Adolescents with ADHD may experience unique effects, compared to peers, on the complex temporal relationships between the NLE, positive parenting, and externalizing and internalizing symptoms.

Keywords: ADHD, Negative Life Events, Parenting Style, Comorbidities

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List of Abbreviations

Abbreviation Full Form

ADHD Hyperkinetic disorder and Attention deficit/ hyperactivity disorder

ICD International Statistical Classification of Diseases and Related Health Problems

DSM Diagnostic and Statistical Manual of Mental Disorders

NLE Negative life events

Parenting Parenting style

PHQ-9 Patient Health Questionnaire-9

SES Socioeconomic Status

ACE Adverse Childhood Experiences

CD Conduct Disorder

ODD Oppositional Defiance Disorder

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Exploring the occurrences of, and temporal relationships between, the negative life events, parenting, and externalizing and internalizing symptoms in Norwegian adolescents with ADHD: Comparisons with general population and a matched control group

Hyperkinetic disorder (ADHD) is a common diagnosis usually found in between 1.4-9% of the general population (Brown et al., 2017; Surén et al., 2018). Symptoms include concentration trouble and hyperactivity. In addition, comorbidities such as conduct difficulties and depression also frequently occur in ADHD. Current research has found a link between symptoms of ADHD and the tendency of having experienced more negative life events (Walker et al., 2021) and less positive parenting in childhood and adolescence (Miranda-Casas et al., 2007). The associations have been argued to occur in either direction, it might be ADHD causing more adverse events as well as less positive parenting to occur (Li et al., 2020), or it might be that the stress accumulates to cause symptoms of ADHD (Reigstad & Kvernmo, 2015). The latter has been illustrated by the polyvagal theory of stress (Porges, 2007) which shows how stress over time, especially during childhood, can cause overlapping symptoms with the ADHD diagnosis. Everyone experiences negative life events from time to time, but the theory of cumulative risk (Evans et al., 2013) suggests that it is the accumulated amount of negative life events that may cause the an increased risk for negative mental health consequences. Negative life events (NLE) include all negative events that can occur in one's life, in a family setting, in peer relations, in relation to oneself and in some studies the surrounding society as well. In addition to adolescents with ADHD being at greater risk of experiencing negative life events (Walker et al., 2021), they have been found to experience harsher and less positive parenting (Miranda-Casas et al., 2007). In a perspective of stress, a child's relationship to their parents can both alleviate and thus protect against the negative effects of stress, or it can cause stress (Nordanger et al., 2011).

The current thesis argues that previous findings concerning adolescents with ADHD may have, to some extent, been inflated due to the comparisons with large normative samples (Kendall et al., 1999); that is, such results may have been significant primarily thanks to larger samples and greater statistical power. In addition, comparisons using case controls have usually only controlled simple covariates, such as age and gender. Against this background, the current thesis has addressed these issues by examining NLE, positive parenting, as well as comorbid symptoms in ADHD adolescents vs. adolescents from both general population

samples and demographically matched paired sample. Further, comorbidities, the co-occurrence of two or more diagnoses simultaneously, are frequent in ADHD, both with externalizing and internalizing symptomology (Jensen & Steinhausen, 2015). In the general population of adolescents these symptoms can occur in association with negative life events (Daviss et al., 2009; Reigstad & Kvernmo, 2015) and with parenting (Gorostiaga et al., 2019; Pinquart, 2017) with the influences possibly going both ways (Briscoe-Smith & Hinshaw, 2006). Since both negative life events and parenting have been found to occur more frequently in those with ADHD compared to general population, the unique influence ADHD might have in the temporal relationships between the externalizing and internalizing symptoms, negative life events, and parenting style, was explored in the current thesis.

Hyperkinetic Disorder (ADHD)

The abbreviation ADHD is used in daily speech in Norway, but the official diagnosis in ICD-11 is hyperkinetic disorder (WHO, 2019). To comply with the diagnostic criteria for the hyperkinetic disorder (hence ADHD) in ICD-10 which was the diagnostic manual used in Norway up till 2019 (WHO, 2016), both significant concentration difficulties and hyperactivity or impulsivity must be present and must be afflicting the individual's functioning in several arenas. To reach the diagnostic criteria for ADHD in the DSM-5 (APA, 2013), a person can have more of one aspect of the disorder and less of another, a presentation of symptoms which would exclude him from complying with the diagnostic criteria in ICD-10. The ICD-11, which is currently in use since 2019, is updated and more like the DSM-5 criteria. Globally, the occurrence of ADHD in children and adolescents seem to vary between 3-9% (Brown et al., 2017; Polanczyk et al., 2007; Walker et al., 2021; Wang et al., 2017), and much of the variance depends on which diagnostic manual is used. The occurrence of hyperkinetic disorder diagnosis in Norway at 12 years of age was, in 2018, estimated to vary from 1.4% to 5.5% of all 12-year-olds' depending on county. In total 5.4% of all boys and 2.1% of all girls were diagnosed (Surén et al., 2018). In a sample of 4,881 northern Norwegian adolescents aged 15-26 years, 5.1% of the adolescents showed clinical-level symptoms of ADHD, without assessing how many of these had actually been diagnosed (Reigstad & Kvernmo, 2015).

Findings, such as a meta-analysis from 2010 (Nikolas & Burt, 2010), show that ADHD does have a clear genetic component. Both the inattention and the hyperactivity dimensions of ADHD are highly heritable, with different genetic factors predicting approximately 71% of inattention and 73% of hyperactivity (Nikolas & Burt, 2010). The

genetic components predicting around 70% however, also implies the presence of one or several environmental factors. One study found that the odds ratios for ADHD increased with the number of adversities experienced (Biederman et al., 1995). In a longitudinal study of 2,232 twins, Stern (2018) found that a twin who experienced more poly-victimization (victimization by several forms of abuse) was more likely to have more ADHD symptoms than his/her non-victimized twin when reaching adolescence (Stern et al., 2018). In addition, there's evidence of an association between having ADHD and at the same time experiencing less positive (Miranda-Casas et al., 2007) and less stable parenting (Li & Lansford, 2018). Interventions have shown that for children with ADHD, improvements in the home environment is associated to improvement in ADHD symptomology (Pisula et al., 2020; Wüstner et al., 2019).

Comorbidities, the cooccurrence of two or more mental disorders, is also common in ADHD (Jensen & Steinhausen, 2015). In a sample of 14,825 Danish children and adolescents with ADHD, it was found that 52% had at least one comorbid disorder (Jensen & Steinhausen, 2015). Conduct difficulties are so common in ADHD that in daily life they are often assumed to be a part of the ADHD diagnosis itself. Some of the common comorbidities to ADHD are conduct difficulties (Jensen & Steinhausen, 2015), depression (Riglin et al., 2021), and dyslexia (DuPaul et al., 2013). Dyslexia itself is, as ADHD, also associated with higher occurrence of negative life events (Anyanwu & Campbell, 2001), as well as with externalizing (Dahle et al., 2011) and internalizing symptoms (Livingston et al., 2018).

Theoretical Background on the Impact of Stress

Consistent findings of associations between ADHD and experiencing more negative life events sparks a discussion of the temporal direction of the association. Which is the causation, and which is the result? Some propose that the genetic liability for ADHD affects the behavior of the diagnosed person, and that it is this behavior that is causing the occurrence of more NLE (Li et al., 2020). Others again believe that NLE, through the accumulation of stress, might be causing the presence of ADHD symptoms (Reigstad & Kvernmo, 2015), without it necessarily being ADHD. But how can stress over time cause symptoms which can be confused with the symptoms of ADHD? Theories on the effect of stress over time in childhood, such as developmental trauma theories, argue that an individual could be misdiagnosed with ADHD due to overlapping symptoms with trauma, and that these would be better helped by the treatment suggestions offered by a trauma diagnosis (Nordanger et al., 2011). Adults who have experienced 3-4 childhood traumas are often given several diagnoses,

rather than just one trauma diagnosis (Nordanger et al., 2011). If someone is mis-diagnosed with ADHD, the overlap of symptoms to trauma does not cover all the usual trauma reactions (van der Kolk et al., 2009), indicating that these cases might receive several diagnoses. Some studies into comorbidities of ADHD support that assumption, for example; those with comorbid ADHD and conduct difficulties are at more risk of having experienced abuse or neglect than those with ADHD alone (Stern et al., 2018).

The polyvagal theory presents a physiological explanation for how the body reacts to stress in different forms (Porges, 2007). Simply explained, the parasympathetic and the automatic response systems regulate how the body relaxes and excites itself in response to various situations. The 10th cranial nerve known as the vagus nerve gives input to the parasympathetic nervous system. The vagus nerve is divided into two, the older dorsal motor nucleus (hence called the vegetative vagus) and the newer nucleus ambiguus (hence called the smart vagus). When the smart vagus is active in inhibiting arousal, the person is fit for social affiliation, the body is relaxed, and the person can give calm attention and responses to the current social situation. When the smart vagal shows withdrawal an arousal occurs, and the body prepares for flight or fight, the person might become aggressive or anxious. The older vegetative vagus can also inhibit arousal but does so past the threshold of being present socially, and the person can be seen as dissociating from the situation or even passing out. This response is known as “playing dead”, to protect oneself from perceived danger, however, different from when playing, the person mentally as well as physically shuts down (Porges, 2007). While a few experiences of unresolved stress might not be of any great harm to a child, theories of developmental trauma propose that repeated stress over time during childhood, in combination with the caretakers failing to bring the child back into a relaxed and safe state, will have developmental consequences on the child- by not training their vagus nerve responses into being prepared for social affiliation in situations where this is most appropriate (Eide-Midtsand & Nordanger, 2017; van der Kolk et al., 2009). At any age, an immobilized or hyperactive person does not necessarily feel safe enough to be able to concentrate, relax, and actively participate in complex social situations (Eide-Midtsand & Nordanger, 2017).

Emotional lability is considered a well-known feature of psychopathology (Beauchaine et al., 2007). Functional deficits of the smart vagus, which might cause this emotional lability, can develop through experiencing too much unresolved stress in formative years (Beauchaine et al., 2007). A child develops the pattern of activation and deactivation from infancy when parents need to regulate their responses for them. It has been found that the smart vagus’ control in general is lower in children with ADHD (Rash & Aguirre-

Camacho, 2012). The smart vagal response pattern is difficult to measure while simultaneously controlling for several influencing factors, thus it has not yet been possible to conclude whether it is a dysregulated smart vagal response that causes ADHD symptoms, or if it is an ADHD disorder that causes a dysregulated smart vagal response, or if another variable altogether causes both (Rash & Aguirre-Camacho, 2012).

Negative Life Events

Having ADHD have been found to be associated with having experienced more of stressful, adverse or negative life events (NLE) (Briscoe-Smith & Hinshaw, 2006; Reigstad & Kvernmo, 2015; Walker et al., 2021). In studying NLE, most seem to use cumulative risk framework, arguing that the number of risk factors a person is exposed to over time will have a dose-dependent negative effect on the developmental trajectory (Evans et al., 2013). The studies using this framework add up negative life events, asking everything from 9-102 questions with either yes/no or gradient responses of whether a person has experienced a particular negative event ever and/or recently. Cumulative risk framework has been applied to see whether the presence of multiple stress factors create a greater risk for mental health disorders exponentially (Bøe et al., 2018; McCrae & Barth, 2008), as well as risk for negative behavioral outcomes (Appleyard et al., 2005).

Positive associations have repeatedly been found between the NLE and ADHD. Using Adverse Childhood Experiences (ACE) as a measure of NLE, Brown (2017), found that children with ADHD were more likely to experience socioeconomic hardship, familial mental illness, neighbourhood violence and familial incarceration compared to their non-ADHD peers. Walker (2021) studied 40,057 participants (8.5% had ADHD) aged 3-17 years, controlling for demographic variables as well as other known risk factors for ADHD, and found that the odds ratio for having ADHD were higher when a child had experienced more ACE's (Walker et al., 2021). Comparing 228 girls (140 with ADHD) aged 6-12, Briscoe-Smith and Hinshaw (2016) found that girls with ADHD diagnosis had experienced significantly more abuse, 14.3% of the ADHD diagnosed girls reported being victims of abuse against 4.5% of the non-ADHD diagnosed. Longitudinal studies have also found connections between ADHD and NLE. For example, a study of 2,491 Puerto Rican 5–15-year-olds (Lugo-Candelas et al., 2021), studying the presence of negative life events over 3 successive years, found that ADHD at year 1 increased the risk of parental maladjustment at year 2 and 3. Parental maladjustment in this study included intimate partner violence, antisocial personality disorder in parent, parental arrest or in jail, parental substance use problems and parental

emotional problems (Lugo-Candelas et al., 2021). Ouyang (2008) looked at a sample of 14,322 (8.3% with ADHD) 7 to 12th graders in the USA over 3 timewaves (T1 in 1995, T2 in 1996 and T3 2001-2002) and found that those with ADHD at T1 were more likely to report experiencing more supervision neglect, physical neglect, physical abuse and contact sexual abuse at T3 compared to those without ADHD (Ouyang et al., 2008). Additive effects between the number of NLEs and the number of symptoms of ADHD have also been found. Humphreys (2019) looked at 214 participants aged 9-14 (15% met the threshold for ADHD) and found that more NLE were associated with showing more ADHD symptoms. Brown (2017) similarly found in a sample of 76,227 participants (8.8% had ADHD) aged 4-17, that the ADHD symptoms in the children seemed to be higher when the ACE scores were higher (Brown et al., 2017).

In addition to ADHD being associated to stressful life events in general, associations are also found to experiencing particularly stressful family environments. A Swedish study of 1,206 10 year-olds, found that despite the high inheritability of ADHD, there were significant differences in the occurrence of ADHD based on the children's environment (Rydell, 2010). Being in a family with single parents or having stepparents, as well as low maternal education and a non-European descent, was associated with high levels of ADHD symptoms. Adding to the risks presented by the demographics of the child, was the risks of experiencing negative life events, especially experiencing family conflicts. The risk of experiencing negative life events was again higher among the less advantageous families (Rydell, 2010). In a sample of 2,043 Norwegian adolescents, lower socioeconomic status was associated with experiencing significantly more marital breakdown in their parents, as well as greater NLE experience (Bøe et al., 2018). In addition, lower socioeconomic status (SES) was a significant predictor of emotional-, conduct-, peer- and hyperactive/inattention problems (Bøe et al., 2018). Considering marital breakdown, Størksen et al. (2006) conducted a study on 8,984 Norwegian adolescents aged 13-19 to look at the effect parents divorcing had on the adolescents. Some, but not all, were negatively affected by the divorce, with the negative outcomes found to be in depression, anxiety, subjective well-being, and in some school results (Størksen et al., 2006). When there was distress among the parents, however, these effects were doubled (Størksen et al., 2006). And as previously noted, both marital divorce and family conflict is more commonly experienced by those with ADHD. Some found that the highest risk for more NLE for those with ADHD, was related to the family and close relations, such as having parents with substance use and psychiatric issues, and experiencing violence from adults, violence from adults and youths, and sexual abuse (Reigstad &

Kvernmo, 2015). In the Pittsburgh ADHD Longitudinal Study, it was found that both mothers and fathers of children with ADHD have a higher rate of alcoholism than parents of non-ADHD children (Molina et al., 2020). In addition, compared to in healthy controls, ADHD symptoms is found to be more common in 17-year-olds whose mothers experience anxiety or comorbid anxiety and depression (Ayano et al., 2021). To summarize, there seems to be a clear connection between having ADHD and experiencing more stress in the form of NLE, especially with NLE occurring in the youths' close relationships (such as parents, family, peers), both before but also after receiving the ADHD diagnosis.

Parenting Style

Moksnes (2019) showed in a study on Norwegian adolescents aged 13–18-years, that having a stable and supportive family environment, marked by coherence, is one of three overarching resilience factors against developing mental health difficulties (Moksnes & Lazarewicz, 2019). The polyvagal theory can again illustrate why the parenting style, and its consistency or lack thereof, is of such importance for a child to develop healthy emotional regulation skills. For example, Hastings (2008) used the polyvagal theory as perspective when finding that vagal regulation mediated the effects between negative control used by mothers and their children's negative adjustment. The authors argue that the functioning of children's emotional regulation, on a physiological level, is shaped by how their parents socialized their children (Hastings et al., 2008). Breaux (2018) looked at emotion regulation in children with and without ADHD (mean age 10 years) and found that supportive parenting practices were associated with better emotion regulation skills for all children, and non-supportive parenting practices was associated with more emotional liability in ADHD children (Breux et al., 2018). In a study of German adolescents it was even found that making improvements in the family climate lead to decreasing ADHD symptoms (Wüstner et al., 2019). Similarly, a Polish study found that providing a twelve-week training program for 199 parents of hyperactive children, decreased the symptoms of inattention and hyperactivity in the children, as well as decreased the symptoms of oppositional defiant symptoms (Pisula et al., 2020).

Findings indicate a tendency to use more negative parenting styles when the child is diagnosed with ADHD (Miranda-Casas et al., 2007). A birth-cohort study in the UK following 180 children with ADHD and 13,568 without ADHD, found that already when the children with ADHD were 3 years old the mothers reported a poorer parent-child relationships and the use of harsher discipline compared to mothers of non-ADHD children (Flouri et al., 2017). The children with ADHD in this study later reported experiencing lower quality of

emotional support and more household chaos compared to their peers (Flouri et al., 2017). Parents of children with ADHD feel increasingly less competent in their parenting role with the rise of perceived difficulties with the child (Miranda et al., 2009). The more stress experienced by mothers of children with ADHD (5-12 years of age), the more likely is the use of lax parenting, over-reactivity, and verbosity toward the child (Miranda et al., 2009).

The consistency or inconsistency in the parenting influences the child's behavior as well as the parenting style itself. In a longitudinal study of 324 adolescents and their parents, it was found that greater inconsistency in parenting in 6th grade was related to delinquent-oriented attitudes in 7th grade, and to greater antisocial behavior in 8th grade (Halgunseth et al., 2013), indicating that parenting consistency as well as style to be influencing the child's later conduct. In a study of the consistency of parenting, involving 184 parents of children in kindergarten, it was found that those parents who felt overwhelmed by the parenting role were more likely to be inconsistent in their responses to the child's negative behavior (Li & Lansford, 2018). In addition, the more symptoms of ADHD a child had, the more inconsistent was the warm parenting behavior shown during positive interactions (Li & Lansford, 2018).

Externalizing Symptoms

Comorbidity, the cooccurrence of two or more diagnoses, is common to ADHD. Jensen and Steinhausen (2015) showed in a Danish study of adolescents aged 4-17 with ADHD that 52% of the ADHD diagnosed had at least one comorbid disorder. Conduct disorder was the most common comorbidity, with a presence in 16.5% of the ADHD population (Jensen & Steinhausen, 2015). In another large birth cohort study with twins, of those with ADHD, 47.8% had comorbid conduct disorder (Stern et al., 2018). Reigstad and colleagues (2015) found that 50.4% of Norwegian adolescents with clinical levels of ADHD symptoms ($N= 241$) had behavioral difficulties within a clinical range vs. only 2% of those without ADHD ($N= 4,881$). A review of the lifespan trajectories of ADHD and comorbidities mentions that the comorbidity to rule-breaking behavior occurs in between 25-80% of the ADHD children and adolescents studied (Franke et al., 2018). The same review mentions that having a comorbid oppositional defiant disorder (ODD) or conduct disorder (CD) with an ADHD diagnosis is a risk factor for later problems as well, such as depression (Franke et al., 2018).

Some studies have looked at whether it is genetics or environmental factors that cause this comorbidity. Thapar (2001) found it to be, in a UK twin study with 2,082 twin pairs aged 5-17, the same genetic component that influence both ADHD and conduct problems, but that

conduct problems had additional environmental factors, both shared and not shared with ADHD. Schei (2016) reported that in a sample of 194 adolescents with ADHD (55.2% boys), of those with comorbid conduct difficulties 87.5% were boys (Schei et al., 2016). The greater adversities experienced by those with ADHD might contribute to more conduct difficulties through environmental mechanisms. In view of the polyvagal theory, Beauchaine (2007) looked at three studies of children and adolescents aged 4-18, and proposed a biosocial developmental model of conduct difficulties (Beauchaine et al., 2007); The theory proposed that vagal deficiency may be present among aggressive children and adolescents. The vagal tone, as well as emotion regulation are largely socialized within the family, meaning that the occurrence of conduct difficulties to a large degree might be due to less than optimal interactions within the child's family from an early age and onward (Beauchaine et al., 2007). The reduction of vagal tone appeared in these studies to occur between the preschool and the middle school years (Beauchaine et al., 2007). Clarke (2002) looked at the attachment style of 19 boys aged 5-10 with ADHD compared to a control group of 19 boys without ADHD. The attachments of the ADHD group were characterized by more emotional responses and out of control affects (Clarke et al., 2002). Children with ADHD might have an inherited impulsivity to produce conduct difficulties; however, the deficiencies in learned emotion regulation might amplify this inherited risk, and the socialization of emotion regulation skill might either buffer against or exacerbate this risk of showing negative conduct (Beauchaine et al., 2007). In other words, children with ADHD might show conduct difficulties due to negative environmental influences, however, compared to non-ADHD children, the influence of environmental factors might seem weaker due to the additional influence of inherited risk.

Just as ADHD is associated to more NLE and less positive parenting practices, so is also conduct difficulties. The association between experiencing more NLE and greater conduct difficulties in adolescents have been observed both in the normative (Flouri & Kallis, 2007) as well as in populations with ADHD. In a sample of 4,881 northern Norwegian adolescents (241 with clinical levels of ADHD), the strongest associations with experiencing more NLE was found in the adolescents with ADHD who presented more conduct difficulties (Reigstad & Kvernmo, 2015). Of those adolescents with ADHD that also showed comorbid conduct difficulties, 67.8% reported 2 or more NLE, against 26.9% of adolescents with ADHD but no comorbid conduct difficulties (Reigstad & Kvernmo, 2015). Another study, looking at girls aged 6-12, found that among ADHD diagnosed girls, those girls who had been victims of abuse showed more externalizing symptoms, such as aggression. They also reported experiencing more peer rejection, but this peer rejection could somewhat be

explained by the higher rates of aggressive behaviour, indicating a reciprocal relationship between externalizing symptoms and some types of NLE (Briscoe-Smith & Hinshaw, 2006).

As NLE is associated both to ADHD and conduct difficulties, so is parenting. A meta-analysis based on 1,435 studies found correlations between worse parental styles and more externalizing symptoms in the general population of children and adolescents (Pinquart, 2017). Externalizing issues being defined as under-controlled behaviors such as aggression, disruptiveness, defiance, hyperactivity, and impulsivity (Pinquart, 2017). It has been found that mothers of children with ADHD use more severe discipline strategies than mothers of children without ADHD (Miranda-Casas et al., 2007). And in cases where a child with ADHD in addition showed oppositional defiant disorder (ODD), mothers were inclined to use even more severe discipline strategies (Miranda-Casas et al., 2007). Walther (2012) found that delinquency was significantly higher in the ADHD group than in a group without, a difference with a large effect size ($d = .99$). For the ADHD group in this study, better parenting strategies in general was related to lower delinquency in children; however, the same was not found in the non-ADHD group (Walther et al., 2012). Unfortunately, the levels of skilled parenting on all measures was in general lower in the ADHD group (Walther et al., 2012). Such results imply that parenting can alleviate some of the risk for externalizing difficulties, at least in adolescents with ADHD.

Internalizing Symptoms

Depression is also frequently comorbid to ADHD. Riglin (2021) found an odds ratio of 1.21 between having childhood ADHD and risk of adolescent major depression. When controlling for sex, early adversity, maternal education, and maternal depression, the association between ADHD and depression still remained robust (Riglin et al., 2021). Jensen and Steinhausen (2015) found in a Danish study of 14,825 ADHD diagnosed participants, depression to be comorbid for 1.6% of the ADHD population (Jensen & Steinhausen, 2015). In a northern Norwegian sample, 52.9% of adolescent with ADHD showed symptoms of emotional difficulties, against only 3.9% of the non-ADHD population (Reigstad & Kvernmo, 2015). Blackman (2005) looked at 1-4 graders with and without ADHD and found that the rate of depression was much higher in children with ADHD than in the general population (Blackman et al., 2005). In a 4 yearlong follow-up study of boys with ADHD compared with boys without ADHD, Biederman (1996) found that at all assessments the boys with ADHD were more likely to have major depression, as well as antisocial disorders and anxiety disorders (Biederman et al., 1996). Later Biederman (2008) also compared 123 adolescent and

young adult females with ADHD, with 112 control females, over 5 years on their risk of major depression. The risk for depression was 5.1 times higher for those with ADHD (Biederman et al., 2008). Schei (2016) reported that in a sample of adolescents with ADHD (55.2% boys), 64.6% of those with comorbid emotional problems were female, and of those presenting with both comorbid conduct and emotional problems 74.4% were still female (Schei et al., 2016).

In a review of ADHD and comorbidities across the lifespan, the authors concluded that despite depressive symptoms being among the common comorbidities to ADHD, surprisingly little is known about how this comorbidity actually develops (Franke et al., 2018). However, as with ADHD and conduct difficulties, some associations have also been found between depression and both NLE and parenting. The association between more NLE to more symptoms of depression have been made both in the general (Phillips et al., 2015) as well as in ADHD populations (Daviss et al., 2009). When studying the relationship between depression and stressful life events, Phillips and colleagues (2015) found that while stress was related to depression, depression did not seem to significantly produce stressful events to occur (Phillips et al., 2015). Daviss (2009) used cross-sectional design to study 104 adolescents with ADHD, controlling for demographics, comorbidities, and ADHD severity, and found significant associations between lifetime depression and environmental adversities (victimization trauma, parent-child conflict) as well as behaviourally independent NLE (current social mal-adjustment, early and current ADHD history) (Daviss et al., 2009). In addition, those with comorbid ADHD and major depression was the least likely to have intact families, followed by those with ADHD, without depression (Biederman et al., 2008).

Looking at parenting and its association to depression, a review of 59 studies on parenting styles and internalized symptoms in adolescence in general, found that authoritarian and negligent parenting styles, as well as inconsistent discipline, negative parentings, family disfunction and over-reactivity from parents are all associated with greater depression in adolescents, with a moderate effect size (Gorostiaga et al., 2019). A systematic review by Deault (2009) on the effects of parenting on ADHD and comorbidities pointed out that there is a lack of research on parental contribution to the development of depression in ADHD, however, a few studies have been conducted. The first study mentioned in the review (Gerdes et al., 2007) found that the children with ADHD who reported greater depression also found both their parents to be less warm and more power assertive compared to ADHD-diagnosed youth without comorbid depression. The second study (Harris et al., 2006) found that children with ADHD and comorbid depression more often had parents who also showed symptoms of

depression or anxiety. The last study found that for children aged 6-8 parenting management style mediated the association between ADHD and depression, while for children aged 10-11 both parent management style and feelings of control mediated the relationship (Ostrander & Herman, 2006). It was recommended that future research use longitudinal methods to explore the relationship between family factors and depression in youth with ADHD (Deault, 2009).

Gaps in Current Research

More negative life events, less positive parenting, and greater externalizing as well as internalizing symptoms have repeatedly been found to occur in adolescents with ADHD, in comparison with the general population. However, the method chosen for estimating and comparing occurrences might influence the results. For example, looking at comorbidities between attention problems, depression, and conduct, McConaughy and Achenbach (1994) illustrated that differences in comorbidity rates that was found, was based on the samples that were utilized. General population samples yielded 21-28% comorbidity between the two studied syndromes, and clinical samples yielded 42-47% comorbidity between the same syndromes (McConaughy & Achenbach, 1994). Another example is differences in sample size between the groups being compared, for example in a Norwegian study on occurrences of NLE in ADHD, which compared the adolescents with ADHD symptoms ($N=241$) to the non-ADHD participants ($N=4,881$) on occurrence of NLE as well as on externalizing and internalizing symptoms (Reigstad & Kvernmo, 2015). Using a larger comparison group to this extent might artificially inflate differences and always generate statistically significant results because of the large sample size, as noted by Kendall and colleagues ((Kendall et al., 1999), page 286): “For example, if one finds a nonsignificant difference between a posttreatment group and a normative group, no matter how small the size of the actual difference between the two groups, one could argue that with more participants and greater power, the difference would eventually become statistically significant.”, yet “researchers will find that the sample size of the normative group is likely to be large relative to the sample size of the clinical group.” (page 293). To adjust the methods used for comparisons when examining the occurrence of NLE, positive parenting, and comorbidities in adolescents with ADHD can thus be more prudent.

Studies of small and clinically relevant samples such as adolescents diagnosed with ADHD might benefit from additional evaluation. For example, because of smaller ADHD groups, it may be difficult to statistically control for several relevant covariates without affecting the power, therefore using a case control method, such as pair-wise exact matching,

can be used to control for several variables just by design. Using a matched control group has also been found to improve performance, compared to using random sub-sample control groups, and thus the sample size requirements to reach statistical power become smaller (Stuart & Lalongo, 2010). Some studies have utilized case control methods, either by just creating control probands from same source population and matching on family risk of ADHD (Biederman et al., 2008), or matching to a non-ADHD diagnosed group not significantly different on the variables age, ethnicity, maternal education, being in a two parent household and maternal education (Briscoe-Smith & Hinshaw, 2006), or matching the cases with ADHD on gender and their self-reported pubertal stage in a control group without ADHD (Humphreys et al., 2019). However, in addition to gender (Schei et al., 2016) and age's (Humphreys et al., 2019) influence, several additional factors have been found to have an influence on the occurrences of both NLE, parenting style and comorbidities, such as having the diagnosis of dyslexia (Anyanwu & Campbell, 2001; Dahle et al., 2011; Livingston et al., 2018), immigrant status (Rydell, 2010), parents' marital status (Rydell, 2010; Størksen et al., 2006), and standard of living (Brown et al., 2017; Bøe et al., 2018; Rydell, 2010).

Another gap in the research on possible differences between ADHD and non-ADHD, is in how parenting style and NLE might influence or be influenced by the adolescents' externalizing and internalizing symptoms over time. Previous studies found a higher occurrence of NLE, and less positive parenting in ADHD-diagnosed, as well as more externalizing and internalizing symptoms. And externalizing and internalizing symptoms was both found to be influenced by and to some degree also influencing the occurrence of NLE and parenting (Briscoe-Smith & Hinshaw, 2006; Daviss et al., 2009; Gerdes et al., 2007; Miranda-Casas et al., 2007; Reigstad & Kvernmo, 2015). In addition, some findings have indicated that the influences from NLE and parenting to conduct and depression, is not the same for adolescents with ADHD as for their peers. For example, there's found difference in parentings influences on child delinquency, such that improving parenting lowered the amount of delinquency in an ADHD group, while the same was not found for the non-ADHD group (Walther et al., 2012). Using a cross-lagged multi-group design, children with ADHD have previously been compared to typically developing children on other factors, finding both a reciprocal relationship between symptom of ADHD and neuropsychological functioning over time, as well as significant differences in the trajectories between the groups, with improvements in neuropsychological functioning not influencing symptoms in the two groups the same (Rajendran et al., 2013). In addition to comparing results from different methods for comparisons, a similar design to Rajendran et al. (2013) will be used to explore temporal

trajectories in, and differences between, ADHD and matched peers. So, the aims of the current study will be to explore these existing research gaps specifically when it comes to the occurrence of negative life events, positive parenting, and externalizing and internalizing symptoms and their associations over time among Norwegian youth with and without ADHD.

Study Aims

The first aim of the current study was to compare adolescents with ADHD and adolescents from general population in Norway on their self-reported occurrence of NLE and positive parenting, as well as on their externalizing and internalizing symptoms. This is mainly done to replicate the findings of differences between these groups, such as has been found many times before.

The second aim was to extend previous findings by exploring the method of case control comparisons. The controls were selected from the same overall sample as used for general population comparisons. The optimization approach was used as an approach to pair-match each individual participants with one control who are as identical as possible on several covariates (Godfrey, 2016); Each participant with ADHD was pair-matched to one control participants who were as exact of a match on 6 covariates as possible. Using a matched control group allows for using smaller samples while controlling for more covariates (Stuart & Lalongo, 2010). The ADHD and matched groups were then again compared on both NLE and positive parenting, as well as on internalizing and externalizing symptoms. Exploring these two different methods can give an indication on whether prior ADHD findings obtained from comparisons with general population samples may have been based on methodological differences, and significant values perhaps driven by large sample sizes of the comparison group. In addition, by using matched controls, differences found was more likely to be due to ADHD. Similar case-control designs and either group or one-on-one matching procedures were used before in multiple studies of clinically relevant small samples (Burdzovic Andreas et al., 2006; Humphreys et al., 2019; Wang et al., 2008).

As a third aim this thesis will utilize path analysis within structural equation modelling (SEM) framework (StataCorp., 2021) to explore whether the temporal relations between NLE and positive parenting to externalizing and internalizing symptoms differ between the ADHD and the non-ADHD matched control group. Exploring whether there are significant differences in how these factors influence each other over time between these two groups, can also indicate which direction further research into how NLE and parenting affects conduct and depression in those with ADHD.

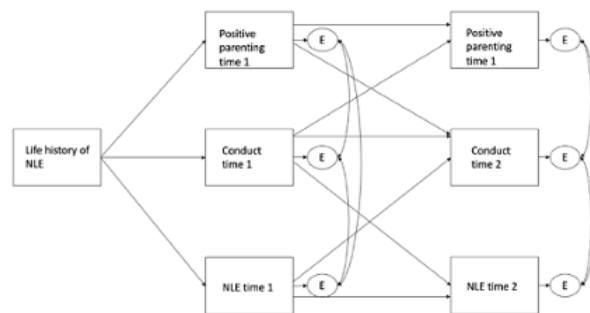
Research Questions

- 1) Compared with general population sample, do adolescents with ADHD report more negative life events, lower levels of positive (i.e., authoritative) parenting, as well as greater internalizing and externalizing symptoms?
- 2) Compared with a clinically matched control group, do adolescents with ADHD report more negative life events, lower levels of positive parenting, as well as greater internalizing and externalizing symptoms? Additionally, compared with a clinically matched control group, do adolescents with ADHD differ on any other study characteristic, such as (non)-participation?
- 3) Do temporal associations between negative life events, positive parenting, and internalizing and externalizing symptoms differ between ADHD-group and a matched control group, and if so, in what ways? This question will be explored using the short-term cross-lagged panel design (See Figure 1).

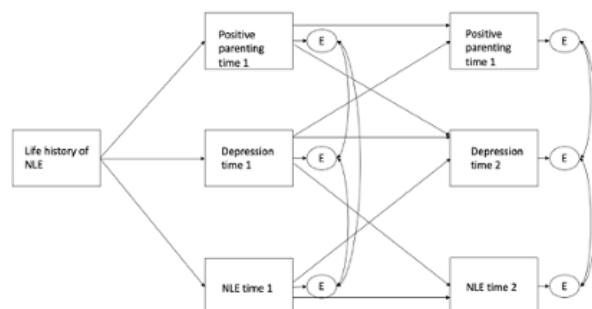
Figure 1.

The two hypothesized Structural Equation Model paths diagrams for (a) externalizing symptoms (b) internalizing symptoms, which each will be run using a multi-group model, i.e., the same conceptual models will be estimated once for ADHD and once for matched control group and then compared.

a) Externalizing symptoms path model



b) Internalizing symptoms path model



Methodology

Data

This study made use of pre-collected data from the Monitoring Young Lifestyles (MyLife) longitudinal project in Norway. The MyLife project's focus is on substance use and related behaviors in Norwegian adolescents (Brunborg et al., 2019). Participants in the MyLife project are 8-10th graders at baseline recruited through their middle schools in Norway (Brunborg et al., 2019). Consents for study participation was obtained from the participants' parents at baseline as participants were underage; they themselves gave their consent through participation. Data has been collected in yearly intervals in the period 2017-2021. Participants were selected from low, medium, and high standard of living areas, and from both rural and urban regions of Norway. A total of 3,512 participants (55% female) were recruited from 33 different schools. The core sample of 3,512 adolescents from middle school grades 8, 9, and 10 who received parental consent at baseline, was invited to participate each year independent of whether they did participate at baseline or the years before, so that participants could move in and out of the study. Data were collected through questionnaires which the adolescents responded to themselves. At T1 baseline in 2017, a total of 2,975 adolescents (of which 87 reported having been diagnosed with ADHD) completed the questionnaire. At the first follow-up in 2018 (T2), a total of 2,857 adolescent completed the questionnaire, including 69 of the adolescents who reported ADHD diagnosis at baseline.

Ethical Considerations

The MyLife study has been approved by the National Committee for Research Ethics in the Social Sciences and the Humanities, and by the Norwegian Data Protection Authority (DPA). The current project involves no contact with participants and no additional data collection but only secondary data analysis using anonymized dataset; as such, the project does not meet criteria for human subject research and no further approvals were required.

Measurements

For the current study, some specific parts of the MyLife study will be utilized. Two timewaves will be used, T1 collected in 2017 and T2 collected twelve months after. At both T1 and T2 participants was asked about their experiences and behavior during the previous twelve months. At the T1 participants were also asked about experiences of negative life events previous to the last twelve months, and this is used as a life history variable.

ADHD. ADHD were identified at T1 through the questionnaire, the participants were asked whether they have an ADHD diagnosis (yes/no).

Negative Life Events. The Negative Life Events (NLE) inventory used is adapted from Newcom, Huba and Bentler (Newcomb et al., 1981) and adjusted for the Norwegian context. The adapted NLE inventory contains 16 questions asked at both T1 and T2. Response alternatives to all questions were “yes, during last 12 months” and “no, never”. At T1 baseline the added option of “yes, previous to the last 12 months” was included to map NLE occurring before the 12 months before baseline as well (i.e., lifetime history); the remaining NLE was computed to reflect the occurrence of any event in the 12 months prior to T1 and T2 assessment. See Appendix B for details.

Positive Parenting. For parenting style, a measure of positive parenting was collected at T1 and T2. This variable consists of the adolescents’ evaluation of their parents’ normal response to a conflict situation with themselves. In two different scenarios the adolescents are asked to rank the likelihood of their parents responding with “discussing the matter calmly”, the first being the adolescents having been out longer than curfew and the other being having gamed more than allowed in their household. The adolescents rank the likelihood of the response “discussing the matter calmly” with scores 1-4 (1: definitely not, 2: probably not, 2.5: don’t know, 3: probably so, 4: definitely so), and an average of the responses to the two different scenarios were given as a score for positive parenting style at both T1 and T2.

Externalizing Symptoms. The MyLife study has measured occurrences of negative conduct in adolescents at both T1 and T2 which will be used in this analysis as symptoms of externalizing difficulties. The 9 questions about conduct difficulties were adopted from the validated “Ung i Norge” (translation: Young in Norway) study (Brunborg et al., 2019) and included the number of occasions the participants engaged in the negative conduct behaviors; Destroyed something on purpose which did not belong to you; lie to your parents or guardians on where you had been or who you were with; got in a serious fight; was out all night without your parents knowing where you were; stole something valuable from others; behaved noisy, were troublesome or acted like a bully in a public place; did you get hurt by or exposed to an accident, so you needed medical attention; did you get exposed to violence leaving visible injuries; did you bully others. The response options to each scenario were never, once or twice, three or four times, and 5 or more times. These individual responses were first recoded into the corresponding mid-point values (for example, the response option of “never” was recoded to 0, while the response option of “three to four times”, was recoded into 3.5) and the conduct scores for each adolescent were computed as the sum of all conduct occasions across

all behaviors, resulting in a scale from 0-45. The conduct variable was in a continuous format with lowest possible score being 0 (only “never” answers) and highest 45 (only “5 or more times” answers).

Internalizing Symptoms. In the MyLife study the Patient Health Questionnaire-9 (PHQ-9; (Kroenke et al., 2001) was used to measure depression symptoms at both T1 and T2. The PHQ-9 asks 9 questions, and the resulting scores are sorted as none (0-4, coded “0”), mild (5-9, coded “1”), moderate (10-14, coded “2”), moderately severe (15-19, coded “3”) and severe (20-27, coded “4”) depression symptoms (Burdzovic Andreas & Brunborg, 2017). This 5-category depression variable was still modeled as a continuous one for ease of analyses.

Covariates. There are 6 variables that will be considered as key covariates, all based on T1 baseline assessment: gender (coded boy/girl), age (grade 8, grade 9, or grade 10 at baseline), self-reported dyslexia (yes/no), community living standard (based on sampling procedures, and coded as low, medium, and high quality of living community), family structure (i.e., parents living together), and language spoken at home (as an indicator of immigrant status if not Norwegian only).

Procedures

The complete MyLife sample was used as participants, all with parental consent, and adolescent consent through participation. All participants who self-reported ADHD was selected as the main “case” group of interest. This ADHD group was compared to both the remaining MyLife sample, as a general population comparison, and to a pair-matched control group which is established from the remaining MYLife sample. To control for certain influencing factors, the ADHD group has been mapped on variables considered relevant for this thesis, listed above as the 6 covariates. These covariates were accounted for in all models, but in different ways. First, in the tests examining differences between the remaining MyLife sample and the participants with ADHD, the covariates will be accounted for statistically. Next, these covariates will be accounted for in the case-control design and group selection, such that the matched control group will be as much as possible exact matches to each ADHD case on all factors, without the need for statistical control in further analyses.

The control group consisted of participants matched one-to-one to the ADHD group on 6 key demographic and health covariates. A matched control group rather than a random sub-sample control group is recommended as it allows for better statistical performance with a smaller sample (Stuart & Lalongo, 2010). The optimization approach was applied to match

each of the ADHD cases with one control who are as similar as possible on 6 covariates (Godfrey, 2016). This approach controls for not only for the covariates but also for the composition of the covariates in each participant, balancing the samples through design. A rule was made to which variables was the most and least important to match on (from most to least important: gender, age, family structure, dyslexia, standard of living, immigrant status). After splitting ADHD cases from the full sample and mapping out each cases combination of the 6 covariates, searched in the remaining sample was done for matches for the ADHD cases. For those without exact matches on all scores, the least important covariate was selected away until there was a good enough match found.

Statistical Analysis

The statistics program StataSE 15.0 was used to conduct all analysis (StataCorp., 2017). As the first step, sample characteristics and all study variables are described, both at T1 and T2. For Research Question 1, exploring differences in NLE, parenting styles, and externalizing and internalizing problems between adolescents with ADHD and the remaining MyLife sample, regression models were used. The regressions examined the role of ADHD, the key variable of interest after accounting for the remaining covariates. For Research Question 2, exploring differences in NLE, parenting styles, externalizing, and internalizing symptoms and – possibly – non-response rates between the ADHD adolescents and demographically matched control group, paired samples dependent t-tests were used. Paired samples t-tests were selected due to the control group being matched one-to-one to the ADHD group, so that one pair can be tested as one case with both ADHD case scores and matched control scores. By using the optimization approach to create a matched control group, each ADHD group participant is matched to one near identical control participant, and thus fewer covariates are needed to be controlled for, as they are already matched on these covariates (Godfrey, 2016).

For Research Question 3, examining differences between the ADHD and matched control group on their temporal relations between NLE, parenting and externalizing and internalizing difficulties, the longitudinal analysis, Structural Equation Models (SEM) (StataCorp., 2021) was used. SEM is a method of illustrating relationships between different observed and latent variables over time, which allows for testing of these hypothetical models of relationships between these variables (Schumacker & Lomax, 2004). In the current thesis a crossed-lagged path models was used, utilizing STATA *-sem* procedure (Huber, 2012). The simpler path models (as opposed to the fully developed SEM models) were used because all

examined constructs were handled as observed variables, while the cross-lagged panel model is selected due to the availability of two time points and an interest their mutual influences over the time. Practical advantages of using path models and SEM general framework is that the hypotheses can be visualized through diagrams, where observed variables are shown as squares, latent variables are shown as ovals, and directionality of examined associations are shown with directed arrows, as shown in the conceptual figure 1 (p. 16) (Kline, 2005). Further, the more specific cross lagged panel models also allow variables to be classified as both exogenous (independent) and endogenous (dependent) in the same model, which is useful when the direction of influence between variables might be uncertain (Schumacker & Lomax, 2004). To compare the ADHD group with the matched control groups paths, multiple-group comparisons were used, which allows for examination of differences in path parameters between the two groups (Schumacker & Lomax, 2004).

All analysis were performed under the supervision and with the assistance of the thesis supervisor. Specifically, I performed all data clean-up, I modified variables, selected cases, did all one-to-one matching, descriptive analysis, summaries, paired samples t-tests and correlations. Due to a 3 month delay in data access it was seen as necessary to conduct regressions, ANOVA and SEM analysis together with the thesis supervisor in order to speed the process up. Tables and figures deviate from APA style by being in font 9, a choice made for easier interpretation and presentation of results.

Data Management

To assist with skewness, scores for depression was divided into 5 categories: none, mild, moderate, moderately severe, and severe. The variables were still modeled as continuous variables for ease of analyses. To reduce skewness for the variable of conduct, participants presenting themselves as clear outliers with exceptionally high scores were re-scored to the top 5% of the distribution (as “10”). Missing data was handled by using the option for full information maximum likelihood when running the structural equation models in Stata. This assumes that data is missing at random (MAR) on the main outcomes of interest; an assumption that cannot really be tested (Allison, 2003). Nevertheless, as part of research question 2, possible differences in missing T2 data were explored cautiously.

Assessing Assumptions for use of Panel-Models and Assessing Model Fit

Panel models assumes variables to be normally distributed. However, accurate parameter estimates also under conditions of non-normality have been found possible using maximum likelihood (Finney & DiStefano, 2006), which was currently used in all estimations. Sample size for SEM analysis is recommended to be 5-10 participants per observed variable (Shanmugam & Marsh, 2016). Using exact matching allows for less stringent model assumptions (Godfrey, 2016), as observed variables such as sex, age, etc. were accounted for through matching and did not need to be added to the conceptual model (Figure 1).

Model fit was evaluated using chi squared (X^2) (a non-significance indicate good fit between the panel model and correlation matrix (Bentler & Bonett, 1980)), as well as normative chi square value (< 3 indicates good data fit (Kline, 2005)). Evaluations of model fit is in addition based on log likelihood (larger value indicates better fit (Kenny, 2015)), root mean squared error of approximation (RMSEA, a value between .05 to .08 is considered a good fit (Schermelleh-Engel et al., 2003)), the comparative normed fit index and the Tucker-Lewis index (values close to .90 or .95 considered good fit (Schumacker & Lomax, 2004)), Akaike's information criterion and the Bayesian information criterion (lower value indicates a better fit (Schermelleh-Engel et al., 2003)).

Results

Participant Characteristics

The MyLife adolescent sample at T1 baseline consisted of 3,512 who consented to participate, and 2,975 (45.24% male) filled out the questionnaire at T1. Of the participants at T1, 2.8% self-reported having ADHD, and 7.0% self-reported having dyslexia. Of the full sample 72.1% had parents who living together. The participants attended 8th grade (36.9%), 9th grade (34.7%) and 10th grade (28.4%). Looking at the resident communities' standard of living, 27.2% of participant was in the worst standard, 39.7% in the mid and 33.1% in the best standard of living area. Most participants spoke only Norwegian at home (87.6%), some spoke both Norwegian and other language at home (10.0%), and a small percentage of participants spoke only another language than Norwegian at home (2.4%). At T2, 2,857 (96.0%) of the participants responded to survey. See table 1 for full overview.

Table 1.*Sample Characteristics for Entire MyLife Sample*

Characteristics		The entire MyLife sample N (%)
N participants	T1	2975 (100)
	T2	2857 (96,0)
Gender	Male	1589 (45.2)
	Female	1923 (54.8)
Grade attending at time 1	8 th	1295 (36.9)
	9 th	1220 (34.7)
	10 th	997 (28.4)
Parents living together at time 1	Yes	2138 (72.1)
	No	827 (27.9)
Community standard of living	Worst	956 (27.2)
	Middle	1394 (39.7)
	Best	1162 (33.1)
Language spoken at home	Only Norwegian	2601 (87.6)
	Norwegian & other	296 (10.0)
	Only other	72 (2.4)
Dyslexia	Yes	209 (7.0)
	No	2766 (93.0)
ADHD	Yes	87 (2.8)
	No	2888 (97.1)

Differences Between ADHD Group and the General Population Sample

To answer research question 1 asking whether-- compared with adolescents from a general population sample, adolescents with ADHD report more negative life events, lower levels of positive (i.e., authoritative) parenting, as well as greater internalizing and externalizing symptoms-- a series of regression models was estimated where the associations between the self-reported ADHD diagnosis and factors of interest was examined, while simultaneously controlling for a range of covariates. Table 2 summarizes outcomes for the entire sample, and the ADHD subgroup alone. The results from the regression analyses are presented in Table 3 (for T1) and Table 4 (for T2).

Table 2.*Key Outcomes and Response Rates for the Full MyLife Sample and ADHD sub-group.*

	Entire sample			ADHD sub-group		
	Life history N = 2961	Time 1 N = 2961	Time 2 N = 2826	Life history n = 87	Time 1 n = 87	Time 2 n = 68
NLE; M (SD)	2.13 (1.99)	.86 (1.27)	1.48 (1.67)	3.20 (2.37)	1.39 (2.13)	2.07 (1.99)
no NLE	22.6%	53.6%	34.9%	10.0%	40.2%	29.5%
Positive Parenting; M (SD)		2.98 (.79)	2.99 (.79)		2.54 (.83)	2.79 (.82)
Depression; M (SD)		.83 (1.03)	1.13 (1.13)		1.51 (1.27)	1.28 (1.25)
None		48.5%	34.1%		22.8%	36.9%
Mild		31.8%	37.6%		35.4%	21.5%
Moderate		11.7%	15.8%		20.3%	26.2%
Mod-Severe		4.2%	6.7%		10.1%	7.7%
Severe		3.8%	5.9%		11.4%	7.7%
Conduct; M (SD)		1.61 (2.47)	2.44 (3.28)		2.84 (3.80)	3.64 (4.14)
No conduct at all		56.1%	42.6%		44.8%	36.2%

Note: NLE= negative life events, depression= as measured by the patient health questionnaire 9.

Occurrences of NLE

The results from the regression model estimating the number of lifetime negative life events (NLE) as reported at T1 baseline (Table 3), shows that the self-reported ADHD diagnosis was significantly associated with greater number of both lifetime (estimate = .56, 95% CI = .21 - .91, $p < .05$) and past-year (estimate = .38, 95% CI = .12 - .65, $p < .05$) NLE. These effects were significant even after accounting for the significant effects of covariates such as gender, parental cohabitation, immigrant background, and age (see Table 3 for details). These differences between ADHD adolescents and the remaining sample in terms of the past-year NLE remained at T2 as well (estimate = .42, 95% CI = .03 - .81, $p < .05$), even after controlling for all socio-demographic covariates (Table 4).

Levels of Positive Parenting

The results from the regression model estimating the level of positive parenting as reported at T1 baseline, show that the self-reported ADHD diagnosis was significantly associated with less positive parenting at T1 (estimate = -.39, 95% CI = -.56 - -.22, $p < .001$). These effects were significant even after accounting for the significant effects of covariates such as parental cohabitation, dyslexia, and standard of living (see Table 3 for details). These

differences between ADHD adolescents and the remaining sample in terms of the past-year positive parenting were seen as a trend at T2 as well (estimate = $-.17$, 95% CI = $-.35 - -.01$, $p < .10$), even after controlling for all socio-demographic covariates (Table 4).

Externalizing Symptoms

The results from the regression model estimating the amount of conduct symptoms as reported at T1 baseline (Table 3), shows that the self-reported ADHD diagnosis was significantly associated with greater number of past year conduct symptoms at T1 (estimate = 1.01 , 95% CI = $.44 - 1.58$, $p < .001$). These effects were significant even after accounting for the significant effects of covariates such as gender, parental cohabitation, and immigrant background (see Table 3 for details). These differences between ADHD adolescents and the remaining sample in terms of the past-year conduct symptoms remained at T2 as well (estimate = 1.05 , 95% CI = $.26 - 1.83$, $p = .009$), even after controlling for all socio-demographic covariates (Table 4).

Internalizing Symptoms

The results from the regression model estimating the symptoms of depression as reported at T1, shows that the self-reported ADHD diagnosis was significantly associated with greater symptoms of depression (estimate = $.63$, 95% CI = $.40 - .85$, $p < .001$). These effects were significant even after accounting for the significant effects of covariates such as gender, parental cohabitation, and age (see Table 3 for details). These differences between ADHD adolescents and the remaining sample in terms of the past-year symptoms of depression did not remain at T2 (Table 4).

Table 3.

Regression models examining T1 NLE, parenting, internalizing and externalizing symptoms in a general population sample as a function of ADHD, after accounting for all study covariates.

	Regression 1		Regression 2		Regression 3		Regression 4		Regression 5	
	Outcome: NLE lifetime		Outcome: NLE T1		Outcome: Positive parenting T1		Outcome: PHQ T1		Outcome: Conduct T1	
	Estimate (coeff.)	95% CI	Estimate (coeff.)	95% CI	Estimate (coeff.)	95% CI	Estimate (coeff.)	95% CI	Estimate (coeff.)	95% CI
ADHD	.56*	.21 - .90	.38*	.12 - .65	-.39***	-.56 - -.22	.63***	.40 - .85	1.01***	.44 - 1.58
Gender (Girl)	.39***	.27 - .51	.45***	.36 - 5.38	.03	-.27 - .08	.53***	.46 - .61	-.41***	-.60 - -.21
Parents together	-.26***	-2.7 - -2.4	-.60***	-.70 - -.50	.06*	-.001 - .12	-.19***	-.28 - -.11	-.53***	-.74 - -.31
Immigrant status	.38***	.21 - .55	.22***	.08 - .35	.02	-.07 - .10	.07	-.05 - .18	.58**	.29 - .87
Age										
Grade 9	.14 *	.003 - .28	.13*	.02 - .23	-.04	-.10 - .03	.16***	.07 - .25	-.04	-.27 - .18
Grade 10	.26***	.12 - .41	.16*	.05 - .27	-.008	-.06 - .08	.32***	.23 - .41	.12	-.12 - .36
Dyslexia	.09	-.14 - .32	.22*	.05 - .40	-.22***	-.33 - -.11	.35***	.20 - .51	.53	.11 - .91
Community Standard										
Level 2	-.03	-.18 - .11	-.10	-.21 - .02	.07*	-.001 - .14	-.04	-1.31 - .06	-.10	-.34 - .14
Level 3 (best)	-.06	-.21 - .09	-.09	-.20 - .03	.08*	.006 - .15	-.09	-.19 - .005	-.16	-.40 - .09

Note. NLE= negative life events; depression symptoms= measured by the PHQ-9 scale; * = p value <.05, ** = p value <.01, *** = p value <.001.

Table 4.

Regression models examining T2 NLE, parenting, internalizing and externalizing symptoms as a function of ADHD vs general population group, after accounting for all study covariates.

	Regression 6		Regression 7		Regression 8		Regression 9	
	Outcome: NLE T2		Outcome: Positive parenting T2		Outcome: Conduct T2		Outcome: Depression T2	
	Estimate (coeff.)	95% CI	Estimate (coeff.),	95% CI	Estimate (coeff.)	95% CI	Estimate (coeff.)	95% CI
ADHD	.42*	.03-.81	-.17f	-.35-.01	1.05*	.26-1.83	.18	-.09-.45
Gender (Girl)	.58***	.46-.71	.06*	.0002-.11	-.58***	-.84-.32	.65***	.56-.73
Parents together	-.75***	-.90-.61	.08***	.02-.15	-.38*	-.67-.10	-.17***	-.27-.08
Immigrant status	.35***	.15-.54	-.06	-.15-.03	.45*	.06-.84	-.14*	.01-.27
Age								
Grade 9	.08	-.06-.23	.007	-.06-.07	.03	-.26-.33	.10*	.005-.20
Grade 10	.34***	.17-.50	.04	-.04-.11	.24	-.08-.57	.32***	.21-.42
Dyslexia	.42*	.16-.68	-.17***	-.29-.05	.59*	.06-1.13	.10	-.08-.29
Community Standard								
Level 2	-.15	-.31-.01	.05	-.03-.01	.06	-.27-.38	-.01	-.12-.10
Level 3 (best)	-.18*	-.34-.02	.02	-.05-.09	-.33	-.66-.003	-.12*	-.23-.01

Note. NLE= negative life events; depression symptoms= measured by the PHQ-9 scale; * = p value <.05, ** = p value <.01, *** = p value <.001; f= a trend, not significant but p under .10.

Differences Between ADHD Group and the Matched Control Group

To answer research question 2 asking whether compared with adolescents in a matched control group, do ADHD adolescents report more negative life events, lower levels of positive (i.e., authoritative) parenting, as well as greater internalizing and externalizing symptoms, first a matched control group was established and then a series of paired samples t-tests were conducted. In addition, possible other differences between the group, such as attrition and response rates, was calculated using ANOVA.

In the full sample, 87 participants self-reported having a diagnosis of ADHD at baseline assessment and these was thus selected as cases in this set of analyses. As shown in Table 5, in the ADHD group 49% were male. 31% of the ADHD group also reported having dyslexia. Of the 87 ADHD participants 52% had parents that were living together. Using grade level as an age indication, 35% were in 8th grade, 33% in 9th grade, 32% in 10th grade at first time point. 45% lived in the best standard of living area, 26% in the middle standard of living area, and 29% in the worst standard of living area. Language spoken at home was mostly, 87% of only Norwegian, 11% spoke Norwegian and other language and only 1% spoke only other language.

To establish a matched control group, which was matched on 6 demographically and health covariates, the optimization approach was used. 81 of the 87 participants had exact matches on all 6 covariates (gender, age, family structure, community of residence standard of living, immigrant status, and dyslexia). For the last 6 control participants, there are only one variable for each participant that they do not match on. 2 matches have different response on language spoken at home, 2 have different score on the community living standard, and 2 have not the same response to whether their parents live together. See table 5. Mean responses, standard deviation, and response rates, for both groups are shown in table 6.

Table 5.*Sample Characteristics for ADHD group and Matched Control Group*

Characteristics		ADHD Group	Matched Group
		N (%)	N (%)
	T1	87 (100)	87 (100)
	T2	69 (79)	83 (95)
Gender	Male	43 (49)	43 (49)
	Female	44 (51)	44 (51)
Grade attending at time 1	8 th	30 (35)	30 (35)
	9 th	29 (33)	29 (33)
	10 th	28 (32)	28 (32)
Parents living together	Yes	45 (52)	48 (55)
	No	42 (48)	39 (45)
Community standard of living	Worst	25 (29)	23 (26)
	Middle	23 (26)	25 (28)
	Best	39 (45)	39 (45)
Language spoken at home	Only Norwegian	76 (87)	77 (89)
	Norwegian & other	10 (11)	10 (12)
	Only other	1 (1)	0 (0)
Dyslexia	Yes	27 (31)	27 (31)
	No	60 (69)	60 (69)

Table 6.*Mean Responses and Response Rates for ADHD group and Matched Control Group*

	ADHD Group			Matched Control		
	Life history	T1	T2	Life history	T1	T2
NLE						
Valid N (%)	87 (100)	87 (100)	68 (78)	87 (100)	87 (100)	83 (95)
M (SD)	3.20 (2.37)	1.39 (2.13)	2.07 (1.99)	2.53 (2.15)	.99 (1.25)	2.08 (2.53)
Positive parenting						
Valid N (%)		84 (97)	68 (78)		85 (98)	82 (94)
M (SD)		2.54 (.83)	2.79 (.82)		2.92 (.93)	2.99 (.77)
Depression						
Valid N (%)		78 (90)	65 (75)		74 (85)	78 (90)
M (SD)		1.51 (1.27)	1.28 (1.25)		.84 (1.02)	1.25 (1.19)
Conduct						
Valid N (%)		87 (100)	69 (79)		85 (98)	82 (94)
M (SD)		2.84 (3.80)	3.64 (4.14)		1.65 (2.71)	2.97 (3.55)

Note. NLE= negative life events; depression symptoms= measured by the PHQ-9 scale.

Occurrences of NLE

The total score of NLE is compared between the ADHD and control group (see table 7 and 8). There was a significant difference in the total experienced NLE in the life history, where the ADHD group (M= 3.20, SD= 2.37) experienced significantly higher number of NLEs than control group (M= 2.53, SD= 2.15) did; $t(86) = 2.60, p = .011$. By conventional standards the difference had a small effect size (Cohen's $d = .279$). The ADHD group did report higher number of NLE also at T1, but this difference was not statistically significant ($p = .16$), while at T2 the mean was practically identical.

Levels of Positive Parenting

At both T1 and T2 the ADHD group reported in average less positive parenting than the control groups (see table 6), however the difference were only significant at T1 (see table 7 and 8). At T1 the ADHD group (M= 2.52, SD= .84) scored significantly lower on positive parenting than the control group (M= 2.92, SD= .93) did; $t(81) = -3.12, p = .0025$. At T2 we can see that the number of pairs of observations sinks from 82 till 64, which might have influenced the power to detect significant differences.

Externalizing Symptoms

The mean scores of conduct problems were higher at both T1 and T2 for the ADHD group than in the matched group (see table 6) however this difference was only significant at T1. A significant difference was found, using paired samples t-test (see table 7 and 8), at T1 where the ADHD group (M= 2.91, SD= 3.82) had higher conduct problem scores than the control group (M= 2.72, SD= 2.72) did; $t(84) = 2.84, p = .006$.

Internalizing Symptoms

The symptoms of depression, based on the patient health questionnaire 9 (PHQ-9) scale, were in average higher in the ADHD group at both T1 and T2 (see table 7 and 8), however the difference was only statistically significant at T1. A significant difference was found using paired samples t-test, at T1 where the ADHD group (M= 1.48, SD= 1.28) had higher PHQ-9 scores than the control group (M= .08, SD= .98) did; $t(66) = 3.65, p = .0008$. Response rates were lowest for the PHQ-9 questions (67 pairs at T1 and 57 pairs at T2) which might have influenced the statistical power to detect differences in symptoms of depression.

Table 7.

Time 1 Mean and Standard Deviation and Paired Samples T-tests on the differences between ADHD and Control Group.

Outcomes at T1	Analytical n	ADHD M (SD)	Matched control M (SD)	t (df)	p-value
NLE lifetime	87	3.20 (2.37)	2.53 (2.15)	2.60 (86)	.01
NLE past year	87	1.39 (2.14)	.99 (1.25)	1.41 (86)	.16
Positive parenting	82	2.52 (.84)	2.92 (.93)	-3.12 (81)	<.01
Depression symptoms	67	1.48 (1.28)	.82 (.98)	3.65 (66)	<.001
Conduct	85	2.91 (3.82)	1.65 (2.72)	2.84 (84)	.01

Note. NLE= negative life events; depression symptoms= measured by the PHQ-9 scale; Significant p-values marked in bold.

Table 8.

Time 2 Mean and Standard Deviation and Paired Samples T-tests on the differences between ADHD and Control Group.

Outcomes at T2	Analytical n	ADHD M (SD)	Matched control M (SD)	t (df)	p-value
NLE past year	65	2.02 (1.92)	2.03 (2.69)	-.04 (64)	.97
Positive parenting	64	2.84 (.78)	2.96 (.77)	-.97 (63)	.34
Depression symptoms	57	1.29 (1.24)	1.16 (1.19)	.63 (56)	.53
Conduct	65	3.61 (4.09)	2.88 (3.79)	1.16 (64)	.25

Note. NLE= negative life events; depression symptoms= measured by the PHQ-9 scale.

Differences in Participation and Response Rates

One discrepancy found between ADHD and control group was in the participation rates (See Table 4 for summary). First, adolescents from the ADHD group were significantly less likely to participate again at T2 than the control group (69/87 vs. 82/87), $X^2(2, N = 86) = 8.4, p = .003$. ADHD adolescents who dropped out were not different from ADHD adolescents who remained in the study on any T1 characteristics, save for older grade ($M = 9.5, SD = .78$ vs. $M = 8.8, SD = 7.7, F(1, 85) = 10.2, p = .002$), greater NLE at lifetime history ($M = 4.3, SD = 2.82$ vs. $M = 2.91, SD = 2.17, F(1, 85) = 4.94, p = .03$), and marginally lower positive parenting ($M = 2.36, SD = .79$ vs. $M = 2.62, SD = .83, F(1, 82) = 2.02, p = .096$). Second, they also tended to have greater non-response rates on all outcome variables at both times (see Table 6). These non-participation and non-response trends likely influenced already small sample sizes and power to detect significant differences.

Structural Equation Models Examining the Short-Term Temporal Associations Between NLE, Parenting Styles, and Internalizing and Externalizing Symptoms Across Adolescents with ADHD and a Matched Control Group

To answer research question 3 --do temporal associations between negative life events, positive parenting, and externalizing and internalizing symptoms differ between ADHD-adolescents and a matched control group, and if so, in what ways-- first, correlation matrixes were performed, shown in Appendix A, and then short-term cross-lagged panel models were conducted, using multi-group comparisons between the samples.

Differences in NLEs and Parenting Styles Influences on Externalizing Symptoms over time

To test whether the paths between NLE, parenting and conduct differed significantly between the ADHD and matched control group, multigroup models were conducted, using both constrained and unconstrained models to compare them for better fit. Constrained models force paths to be equal across the groups so that there are no differences in the examined processes between these two groups, while unconstrained models free the paths to be unequal thus estimated for each group separately. The fit indices for the constrained model, using maximum likelihood for missing data, were $\chi^2(28) = 106.69$; $p < .01$; χ^2/df ratio = 3.81; log likelihood = -2293.53, RMSEA = .15, CFI = .32, AIC = 4643.06, BIC = 4731.51. The fit indices for the unconstrained and using maximum likelihood for missing data model, (see table 9) exhibited good fit, as indicated by the non-significant chi-square value (i.e., $\chi^2(56) = 17.83$; $p = .06$; χ^2/df ratio = .32; log likelihood = -2249.10); RMSEA-values close to .06 (i.e., RMSEA = .10), and CFI values above .90 (i.e., CFI = .92), and comparable AIC and BIC values (i.e., AIC = 4610.19; BIC = 4787.10).

Except for the Bayesian information criterion, all fit indices imply that the unconstrained multigroup model was a better fit than this constrained model. The chi square difference between the constrained and unconstrained model was significant (difference $\chi^2(-28) = 88.86$; $p < .01$), allowing for a rejection of the null hypothesis of equality of model parameters between the groups. The unconstrained model proving to best fit, this model was used for comparing the multi-groups models. See figure 2 for the unconstrained cross-lagged paths for (a) the ADHD group and (b) the matched control group.

Table 9.

Goodness of Fit Indices for Structural Equation Models Examining Associations between NLE, Positive Parenting, and Externalizing Symptoms; Multigroup Comparisons.

Model	Constrained model	Unconstrained model
X ²	106.69 (<i>p</i> < .001)	17.83 (<i>p</i> = .06)
Normative chi square (x ² /df)	3.81	0.32
Log likelihood (df)	-2293.53 (28)	-2249.10 (56)
RMSEA	0.15	0.10
CFI	0.32	0.92
TLI	0.24	0.67
AIC	4643.06	4610.19
BIC	4731.51	4787.10

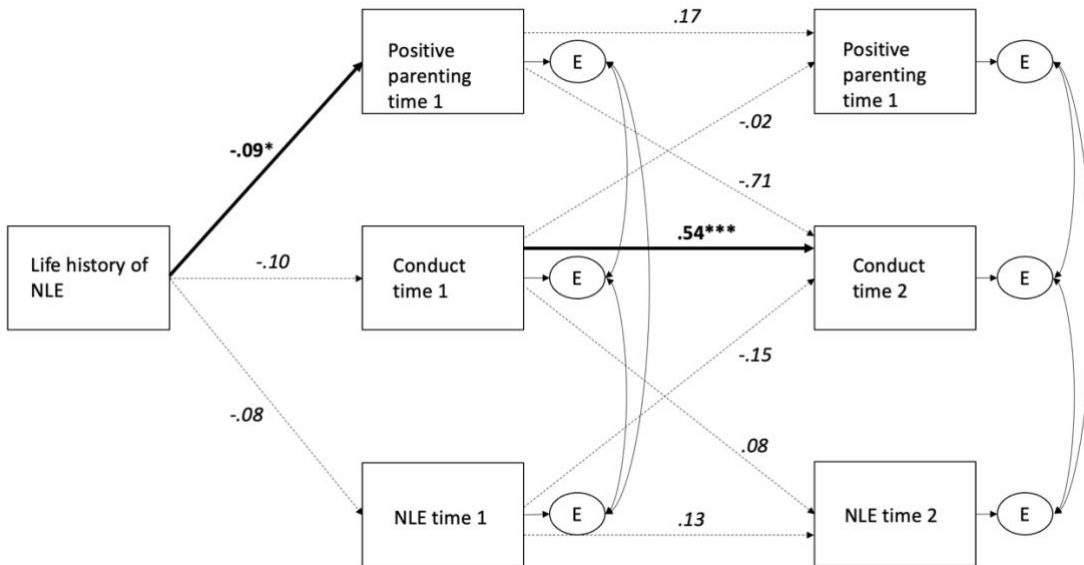
Note. X²= chi-squared; df= degree of freedom; RMSEA= root mean squared error of approximation; CFI= comparative normed fit index; TLI= Tucker-Lewis index; AIC=Akaike's information criterion; BIC= Bayesian information criterion.

The only significant path for both ADHD and matched group was the auto-regression (i.e., temporal stability) path between conduct at T1 and T2, such that participants who reported greater conduct problems at T1 also tended to report greater problems at T2. ADHD participants showed a significant path from having experienced more negative life events in life history to experiencing less positive parenting at T1, no other cross-lagged path was significant. In the matched control group however, auto-regression (i.e., temporal stability) paths were found from parenting, conduct, and NLE at T1 to their repeated measure at T2. In addition, there was a significant path from NLE at T1 to conduct at T2, indicating that more NLE at T1 was associated to greater conduct issues at T2.

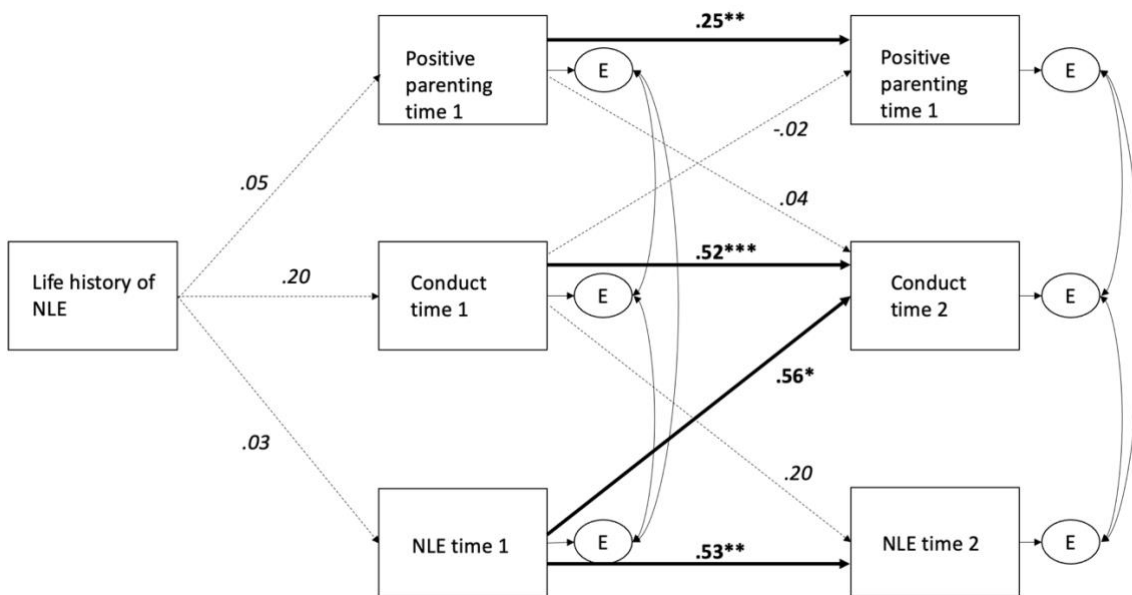
Figure 2.

Unconstrained cross-lagged panel models for externalizing symptoms; multigroup comparison.

a) ADHD group



b) Matched Control group



Note. significant paths marked in **bold**. NLE= negative life events; P values marked as * $<.05$, ** $<.01$, *** $<.001$, $f <.10$.

Differences in NLEs and Parenting Styles Influences on Internalizing Symptoms over time

To test whether the paths from NLE, parenting and to depression differed significantly between the ADHD and matched control group, first, correlation matrixes were conducted (see Appendix A) and then short-term cross-lagged panel models were conducted, using multi-group comparisons between the samples.

The fit indices for the constrained model looking at internalizing symptoms, which were divided by ADHD and control group, constrained, and using maximum likelihood for missing data were $\chi^2(28) = 121.16; p < .01; \chi^2/df$ ratio = 4.33; log likelihood= 1884.11; RMSEA=. 16; CFI= .43; AIC= 3824.22; BIC= 3912.67. TLI were lower than .90. The fit indices for the unconstrained model estimated with maximum likelihood for missing data, indicated a better fit, indicated by the chi square divided by degree of freedom ration being below 3 (i.e., χ^2/df ratio = .38; log likelihood= -1834.08). The significant chi square value (i.e., $\chi^2(56) = 21.10; p= .02$) indicated again a significant difference between the predicted model and observed data, however, the unconstrained model exhibited a better fit to the data than the constrained model. Other indices of a better model fit were the RMSEA value being closer to .06 than the constrained model (i.e., RMSEA=.11), and CFI values above .90 (i.e., CFI= .92), and comparable AIC and BIC values (i.e., AIC= 3780.15; BIC= 3957.06). TLI were lower than .90.

Table 10.

Goodness of Fit Indices for Structural Equation Models Examining Associations between NLE, Positive Parenting, and Internalizing Symptoms; Multigroup Comparisons.

Model	Constrained model	Unconstrained model
χ^2	121.16 ($p < .001$)	21.10 ($p= .02$)
Normative chi square (χ^2/df)	4.33	0.38
Log likelihood (df)	-1884.11 (28)	-1834.08 (56)
RMSEA	0.16	0.11
CFI	0.43	0.92
TLI	0.37	0.68
AIC	3824.22	3780.15
BIC	3912.67	3957.06

Note. χ^2 = chi-squared; df= degree of freedom; RMSEA= root mean squared error of approximation; CFI= comparative normed fit index; TLI= Tucker-Lewis index; AIC=Akaike’s information criterion; BIC= Bayesian information criterion.

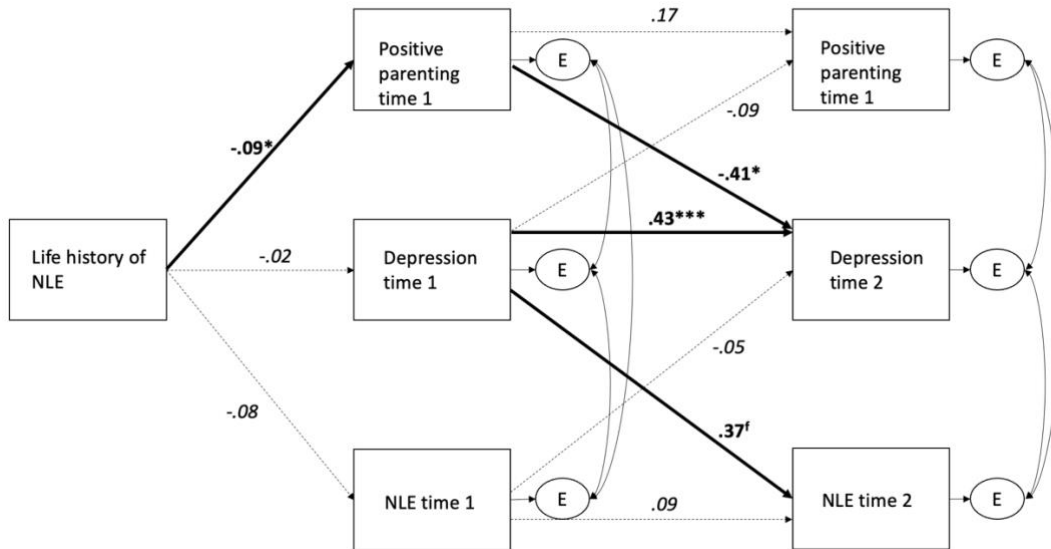
Except for the Bayesian information criterion, all fit indices imply that the unconstrained multigroup model was a better fit than the constrained model. The chi square difference between the constrained and unconstrained model was significant (difference $\chi^2 (-31) = 100.06; p < .001$), allowing for a rejection of the null hypothesis of equality of parameters between the groups. The unconstrained model proving to best fit, this model was used for comparing the multi-groups models. See figure 3, below, for the unconstrained cross-lagged paths for (a) the ADHD group and (b) the matched control group.

For both the ADHD group and the matched control group the autocorrelational path between depression at T1 and T2 were significant and positive, indicating that greater depression at T1 was associated to greater depression at T2 as well. There was additionally significant path from parenting at T1 to depression at T2 for both groups, however, this path were of opposite directions. For the ADHD group the path indicated an association from greater positive parenting at T1 to lower depression symptoms at T2; however, in the matched control group the path indicated an association from greater positive parenting at T1 to greater depression symptoms at T2. A significant path was seen from life history of NLE to positive parenting at T1 for the ADHD group, but not for the matched control group. A trend, not reaching significance, was also found for the ADHD group from experiencing more depression at T1 to experiencing more NLE at T2. In the matched control group, an autocorrelational path from positive parenting at T1 to T2 was significant, but not for the ADHD group. See figure 3 for all significant and un-significant path estimates.

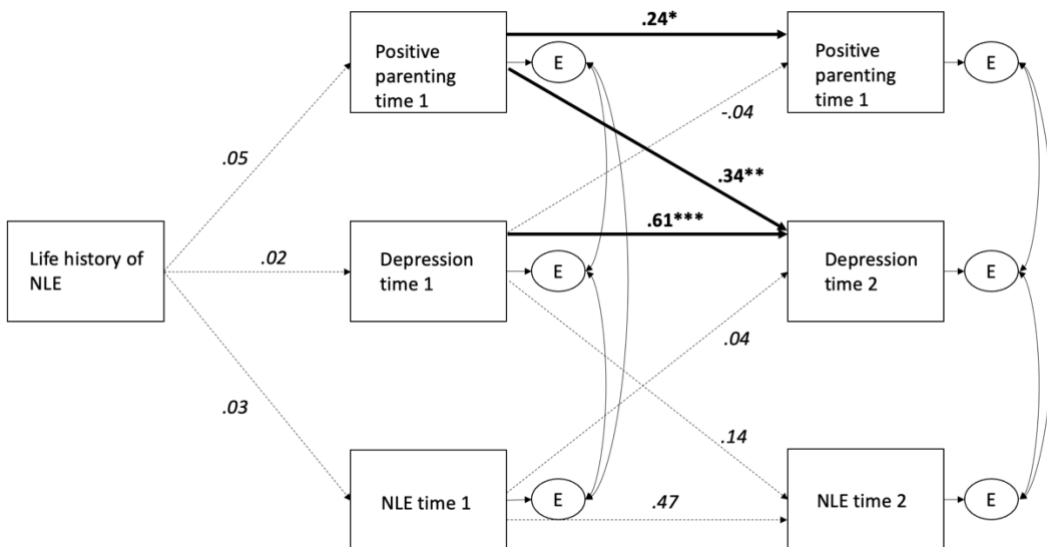
Figure 3.

Unconstrained Cross-Lagged Panel Models for Internalizing Symptoms; Multi-Group Comparison.

a) ADHD group



b) Matched control group



Note. significant paths marked in **bold**; depression measured by Patient Health Questionnaire 9; NLE= negative life events; P values marked as * < .05, ** < .01, *** < .001, ^f < .10.

Discussion

Previous findings, predominantly from comparisons with large samples from general population, have found that adolescents with hyperkinetic disorder (ADHD) tend to experience more negative life events (NLE) (Reigstad & Kvernmo, 2015), less positive parenting (Miranda-Casas et al., 2007), as well as greater externalizing (Jensen & Steinhausen, 2015) and internalizing symptoms (Riglin et al., 2021). Both externalizing and internalizing symptoms are commonly found to be either influenced by or influencing NLE and parenting (Briscoe-Smith & Hinshaw, 2006; Phillips et al., 2015). The current thesis addressed related issues using a sample of 3,512 Norwegian adolescents (2.8% with ADHD) assessed twice (T1 and T2) over a 1-year period.

Main findings

First, the current study has in research questions 1 and 2 re-engaged findings of the higher occurrences, using both general population sample and a clinically relevant sample extracted from the general population sample, to explore whether such findings would be replicated depending on the choice of analytical method. The results indicated good replication of most results across methods, at the first year and in life history data. However, attrition at the second year seemed to influence the statistical power when using the method of case control but not general population comparisons. Not influenced by attrition at T2, a discordancy with previous findings was currently found in occurrences of NLE; While those with ADHD did experience more NLE at T1 and T2 compared to general population, they did not experience more NLE at either T1 or T2, compared to matched controls.

Secondly, because comorbidities frequently coincide with ADHD (Jensen & Steinhausen, 2015), in research question 3, conduct issues was explored as a form of externalizing symptom, and depression as a form of internalizing symptom. Both externalizing and internalizing symptoms in adolescents from general population are commonly found to be either influenced by or influencing NLE and parenting (Walther et al., 2012), both of which are known to be experienced more frequently by adolescents diagnosed with ADHD. Therefore, the current study explored whether ADHD has a unique effect on the temporal interplay between the occurrence of NLE, positive parenting, and externalizing or internalizing symptoms, compared with a matched control group. Findings indicated differences in both temporal relationships between NLE and parenting to conduct difficulties and to depression. In addition, an uncommon lack of stability in parenting style and NLE over time was found in the ADHD group.

Answering Research Question 1

Research question 1 asked whether --when compared with general population sample—do adolescents with ADHD report more negative life events, lower levels of positive (i.e., authoritative) parenting, as well as greater externalizing and internalizing symptoms? This question was answered using regressions on the full MYLife sample. In table 13, results for research question 1 and 2 are listed and compared. After statistically accounting for a range of relevant covariates, ADHD was found to still be a significant predictor of both experiencing more NLE in life history and both T1 and T2. ADHD was also found to be a significant predictor of experiencing less positive parenting at T1 but not quite so at T2 (there was a statistical trend however). When it came to externalizing symptoms, ADHD was a significant predictor of more conduct difficulties at both T1 and T2, even after statistically accounting for all study covariates. Looking at internalizing symptoms, ADHD was a significant predictor of greater depression at T1 but not at T2. The PHQ-9 scale had a low response rate, only 65 of 87 with ADHD answered at T2, which might have influenced the power to detect a difference.

Answering Research Question 2

Research question 2 asked whether -- when compared with a clinically matched control group—do adolescents diagnosed with ADHD report more negative life events, lower levels of positive parenting, as well as greater externalizing and internalizing symptoms? Additionally, compared with a clinically matched control group, do adolescents with ADHD differ on any other study characteristic, such as (non)-participation? This question was answered using paired samples t-tests to test for differences between the individual ADHD and matched control pairs. In table 11, results are shown in comparison to results of research question 1. Adolescents with ADHD reported more NLE in life history, but not significantly so at T1 and T2, than their matched controls. The ADHD group also did report less positive parenting at T1, but not significantly so at T2. When it came to externalizing and internalizing symptoms, the ADHD group did report more symptoms of both, but only significantly so at T1, not T2. Adolescents with ADHD showed greater attrition in participating at T2, which may have impacted the analysis more when comparing against a matched control group: for example, there were no significant group differences in any of the examined variables at T2. This may be because many participants from the ADHD group either did not participate or did not respond to the PHQ-9 scale at T2 reducing some t-tests to only 57 matched pairs.

Differences in Results Based on Analytical Method

The purpose of utilizing both normative and case control comparisons was to explore what, if any, differences there were in results by using the different analytical methods on the overall same sample. The summary of results as to whether adolescents with ADHD experience more NLE, less positive parenting, more externalizing and internalizing symptoms, based on method of comparison, is shown in table 11. Based on method, differences in results were found in questions regarding NLE at both T1 and T2, and externalizing symptoms at T2. These findings might to some degree be due to matching on the covariates which are also found to be associated to experiencing more NLE and externalizing symptoms, such as dyslexia (Livingston et al., 2018). However, attrition was higher in the cases with ADHD, with those not continuing to participate at T2 reporting more lifetime NLE and lower positive parenting at T1. Therefore, it is possible that some of the results from research question 1 (i.e., T2 parenting) was affected. In addition, with the response rate to the PHQ-9 scale, measuring depression, being lower than for the rest of the questions asked, this might have affected the results to research question 1 and 2 regarding occurrences of depression.

Table 11.

Differences in Findings Per Method for Comparisons between ADHD and General Population or Matched Control Groups.

Statistically significant findings	General population comparisons			Matched control comparisons		
	Life history	T1	T2	Life history	T1	T2
ADHD diagnosed experienced significantly more NLE past year	<i>Yes</i>	Yes	Yes	<i>Yes</i>	No	No
ADHD diagnosed experienced significantly less positive parenting past year		<i>Yes</i>	<i>No</i>		<i>Yes</i>	<i>No</i>
ADHD diagnosed showed significantly more externalizing symptoms past year		<i>Yes</i>	Yes		<i>Yes</i>	No
ADHD diagnosed showed significantly more internalizing symptoms past year		<i>Yes</i>	<i>No</i>		<i>Yes</i>	<i>No</i>

Note. NLE= Negative life events, externalizing symptoms= symptoms of behavioral conduct issues, internalizing symptoms= depression as measured with PHQ-9 scale. Different results by method of comparison marked in bold, same results across methods marked by italics.

Answering Research Question 3

Research question 3 asked whether temporal associations between negative life events, positive parenting, and externalizing and internalizing symptoms differ between adolescents

with ADHD and a matched control group, and if so, in what ways? This question was answered using SEM estimation of a cross-lagged panel model with multiple group comparisons between the ADHD group and the matched control group. Models proved better fit when allowing ADHD and matched control group to be separate and unconstrained. There were significant differences in the temporal relationships between ADHD and matched control group. Findings showed a significant difference in the paths between NLE in life history and positive parenting at year 1. In the ADHD group this path indicated significant association between greater earlier NLE and lower positive parenting, while in the matched control group this path was not significant. In the ADHD group there was a lack of significant autocorrelation paths in positive parenting style for the ADHD group, while this autocorrelation was significant for the matched control group. The lack of temporal stability in parenting styles across the relatively short period of one year is rather unusual and might be indicative for a negative tendency for lesser stability in the parenting styles experienced by the ADHD group. Differences were also found between the groups in NLE's and parenting styles relation to symptoms of conduct and depression over time. For the matched control group more negative experiences at year 1 was associated to greater conduct difficulties at year 2, the same was not found for the adolescents with ADHD. For both groups, parenting at year 1 did influence depression at year 2. For the adolescents with ADHD more positive parenting was associated with less depression. However, for the matched control group more positive parenting was associated with greater depression. For the adolescents with ADHD, a trend, not quite reaching statistical significance, was also found for greater depression at year 1 to be associated with more NLE at year 2, this was not found for the matched control group.

Replication and Extension of Previous Research

Compared to previous studies, fewer of the current participants reported ADHD: specifically, ADHD was reported by 2.9% of our full sample, while another Norwegian study reported ADHD in 5% of their sample (Reigstad & Kvernmo, 2015). The current study used participants' self-report of a known/diagnosed condition as a measure of ADHD, while Reigstad and Kvernmo (2015) measured symptom levels of ADHD. The lower rate of ADHD in the current study might be due to several reasons; for example, not everyone who could reach clinically significant levels of ADHD symptoms seeking to be formally diagnosed, or adolescents not wishing to disclose of their diagnosis or being unaware of having been diagnosed in childhood. A Swedish study, found that there were significant differences in the occurrence of ADHD based on the children's environment; being in a family with single

parents or having stepparents, low maternal education, being of non-European decent, were all associated with higher levels of ADHD symptoms (Rydell, 2010). Correlations (see table A1 in Appendix A) completed in the current study on the full MyLife sample, for the purpose of SEM analysis, showed that ADHD diagnosis was significantly associated with parents not living together, and with dyslexia diagnosis. There were no significant correlations between having ADHD and gender, age, immigrant status or the standard of living.

The current thesis replicated previous studies on the occurrence of more NLE experience by adolescents with ADHD compared to the general population (Reigstad & Kvernmo, 2015). In the current study, among the full sample ($N = 2,975$) it was found that ADHD at T1, when controlling for 6 covariates, was predictive of reporting more NLE in the life history (estimate= 0.56), and more NLE in the past year at T1 (estimate= 0.38). Finding influence of ADHD on future NLE, Ouyang (2008) found that having ADHD in 1995 predicted experiencing more abuse and neglect in 2001. The current study did not replicate Ouyang's (2008) findings, as reporting ADHD at T1 was not a significant predictor of reporting more NLE occurring in the past year at T2. Some previous findings have also been made using case controls, for example, Briscoe-Smith and Hinshaw (2006) found that ADHD cases experienced more NLE, in the form of abuse, compared to matched controls, with the controls being matched on age, ethnicity, maternal education and whether being in a two-parent household. In the current thesis extensions were made to these previous findings, using exact matching to control for 6 covariates (age, gender, parental living situation, county standard of living, immigrant status, dyslexia) and the composition of these covariates by pair-matching. The current study found that the ADHD group still experienced an average 0.67 more NLE at life history. However, there were no statistically significant differences in occurrence of NLE in the past year between the groups at either T1 or T2. This lack of difference could be due to the covariates currently controlled for, which are also known to influence the occurrence of NLE, such as dyslexia (Anyanwu & Campbell, 2001). In addition, the dropout at T2, reducing the ADHD cases with almost 1/4th of the original sample, where those who dropped out reported more NLE in life history than those who continued to participate, might have both affected the differences in samples, and reduced statistical power.

The current thesis replicated previous findings on the occurrence of less positive parenting styles experienced by adolescents with ADHD (Flouri et al., 2017; Miranda-Casas et al., 2007). Results from the current study revealed that having an ADHD diagnosis was a significant predictor of a lower score on the positive parenting scale at T1 (estimate= -0.39) and at T2, but only as a statistical trend (estimate= -0.17). In the full sample we found that

other predictors of reporting less positive parenting style were having parents not living together at T1, standard of living at T1, and if the adolescent reported also having dyslexia at T1. It is worth mentioning that while not of interest in the current study, there are other influences on parenting as well. Further extensions on these previous analyses were done by using the same cases of ADHD and selecting a clinically relevant case control group using exact matching from the general population sample, and by further comparing positive parenting reported by the two groups. The ADHD group still reported an on average, 0.4 lower positive parenting score, which represented statistically significantly less positive parenting at T1, but not a time 2. In addition to previous findings on the use of less positive parenting, some findings also indicate that the parenting is less consistent for children and adolescents with ADHD (Li & Lansford, 2018). Replicating these findings in the cross-lagged panel model, the current study found that positive parenting was not stable from T1 to T2 for the ADHD group, while it was for the matched control group.

Looking at common comorbid symptoms to ADHD, the current thesis replicated previous findings on the occurrence of more symptoms of both conduct difficulties and depression experienced by adolescents with ADHD compared to the general population. In a Danish study conduct disorder was seen in 16.5% of the ADHD diagnosed participants (Jensen & Steinhausen, 2015), and in a Norwegian study the presence of conduct difficulties of a clinical range was seen in 50.4% of the ADHD diagnosed adolescents participating (Reigstad & Kvernmo, 2015). In the current study, having an ADHD diagnosis was associated with significantly more symptoms of conduct difficulties at both T1 (estimate= 1.01) and at T2 (estimate= 1.05). In the aforementioned Norwegian study, 52.9% of adolescents with ADHD reported symptoms of emotional difficulties (Reigstad & Kvernmo, 2015). In the current study, having an ADHD diagnosis was associated with significantly more symptoms of depression at T1 (estimate= 0.63) but not at T2. Further, using a matched control group the current thesis was able to extend on these previous findings. Compared to the matched control group ADHD cases experienced significantly more conduct difficulties at T1, with ADHD group reporting on average 1.26 more conduct problems in the last year. Looking at symptoms of depression, the ADHD group reported an average of 0.66 more symptoms of depression at T1, a significant difference. At T2 there were no differences in either symptom. This might be due to the greater attrition in the ADHD group at T2, and for depression the overall low response rate might have influenced the statistical power to detect differences.

When examining attrition, the fallout from the matched control group was found not to be associated with any of the study variables. However, for the ADHD case sample this was

not the case. Previously, some have found higher participation dropout among participants with parents with non-native first language (Eisner et al., 2019). This was not the case for the current study. Eisner (2019) also found that ADHD, conduct problems and internalizing problems predicted drop-out (Eisner et al., 2019). In the current thesis, adolescents with ADHD who did not participate at T2, reported significantly more NLE and less positive parenting at T1, as well as higher attending grade at T1, than those who did participate at T2. However, there was no difference in those who did and did not continue to participate, on immigrant status, standard of living, gender, dyslexia diagnosis, and parents' marital status and neither on externalizing nor internalizing symptoms.

Previous findings have indicated that both externalizing and internalizing symptoms are associated with the amount of NLE one experience and with less positive or less stable parenting. Little is known about the possible differences in these associations between adolescents with and without ADHD. Here it needs to be mentioned that there are additional risk factors for conduct problems, such as pubertal timing or school-related variables (Storvoll & Wichstrøm, 2002), and for depression, such as inherited risk (Thapar et al., 2012), which in the current thesis were not explored. However, the current study did explore this knowledge gap relating to the temporal relation between parenting and conduct and depression was explored. This was done by comparing ADHD group with matched control group on temporal association between NLE, parenting, and the comorbidities, using multi-group comparisons of cross-lagged panel models. To begin with, the path models proved better fit when the ADHD cases and matched controls were separated and all paths estimated freely (i.e., unconstrained), indicating an overall significant difference between the two groups on the explored temporal relationships. When looking at the comorbidities association with NLE, it has been found that adolescents with ADHD and conduct difficulties are reporting even more NLE than adolescents with ADHD but without conduct difficulties (Briscoe-Smith & Hinshaw, 2006; Reigstad & Kvernmo, 2015). In the current study, comparisons showed that for ADHD cases, at no timepoint (life history, T1 or T2) was NLE related to later conduct, neither was conduct related to later NLE. However, in the matched control group, more NLE at T1 was associated with greater conduct symptoms at T2. This is indicating that NLE may have a larger effect on conduct in the non-ADHD sample than in the ADHD sample in the current study. This is in line with Beauchaine et al's (2017) findings, which indicated that the inherited risk for conduct problems in adolescents with ADHD might alleviate some of the effect of NLE on conduct. When it comes to NLEs association with comorbid depression, Daviss (2009) found significant associations between lifetime depression and environmental adversities and NLE

in participants with ADHD (Daviss et al., 2009). In the current study, comparisons showed for both ADHD cases and matched controls that NLE in life history or at T1 was not associated with later depression. But depression at T1 did show a trend of being associated with NLE at T2 in the ADHD group. The same was not found in the matched control group. A similar finding was made by Daviss and Diler (2012), where adolescents with ADHD and comorbid major depressive disorder (MDD) reported more adverse life events 8 months later, compared to adolescents with ADHD but without MDD. The adverse events they reported more of was of sorts that was thought to possibly be affected by the adolescents own behaviour (Daviss & Diler, 2012). It might be that adolescents with ADHD and comorbid depression behave differently than their peers, and that their behaviour influence some forms of NLEs to occur.

Looking at parenting's temporal relationship with the comorbid symptoms, parenting style has also been found to influence the occurrence of conduct difficulties in the general population of adolescents (Pinquart, 2017), as well as in adolescents with ADHD (Miranda-Casas et al., 2007). Some evidence shows that parenting influence delinquency less in the non-ADHD population compared to the ADHD population (Walther et al., 2012). In the current study, parenting at T1 was not associated with conduct at T2 for either ADHD or matched control group. Neither was the opposite found, conduct at T1 was not associated with parenting at T2 for either group. Parenting style is also previously found to influence the occurrence of depression in the general population of adolescents (Gorostiaga et al., 2019) and to be related to depression in those with ADHD (Gerdes et al., 2007). In the current study there were significant association between parenting at T1 with depression at T2 for both ADHD and matched control groups. The direction of the relationship however was not the same, for the ADHD group more positive parenting at T1 was associated with less symptoms of depression at T2. For the matched control group more positive parenting at T1 was associated to more depression at T2. Why this occurs is unknown, but a possible explanation might be if those without ADHD find the positive parenting style to be intruding.

In addition to evidence of less positive parenting styles being used on ADHD adolescents (Miranda-Casas et al., 2007), there are evidence of the parenting style being less consistent when the adolescent has ADHD (Li & Lansford, 2018). In the current study, significant autocorrelation between parenting at T1 and T2 were found for the matched control group, but not for the ADHD group, showing consistency with previous findings. In studies of parenting in ADHD findings indicate that more stress parents report in their experience of the parenting role, the less positive parenting they apply (Miranda et al., 2009). While not measuring the parents own experience, in the current study greater life history of

NLEs was associated with less positive parenting at T1 in the ADHD group. No such association was found in the matched control group. The questions of NLE (see Appendix B) ask to a large degree about events in the adolescent's family, which indicate chances of the NLE also being present for the parents. Further research is needed to explore this relation.

Generalizability

Sampling for the MyLife study took several steps to ensure representativeness. First it ensured geographical and sample diversity in Norway, then representation of both rural and urban areas and third, representations from low, middle and high standard of living communities was ensured (Brunborg et al., 2019). This sample was used for the current general population comparison, and for the case group, all the self-reported cases of ADHD were used. When using a matched control group, and especially exact matching, a downside is the control group not being representative to the general population (Mann, 2003). However, in the current study the aim is rather to evaluate how much the diagnosis of ADHD influence the occurrence, rather than comparing those with ADHD with just a representative population. Two biases are common in case-control design, one is the risk of sampling bias when selecting the case and control groups (Mann, 2003). In the current study this has been avoided by using all cases of self-reported ADHD in a general population sample as cases, and then using the optimization approach for creating a control group consisting of exact matches to the cases. A second common bias is in the retrospective recall when measuring variables (Mann, 2003), there is always a risk for the current state to influence the retrospective recall of occurrences. The longitudinal design eliminates some of this bias by repeating measurements a year later, so that all retrospect measurements are not recalled and measured at the same time. In the current thesis where the goal is to establish which effect ADHD, when controlling for other covariates, have on occurrences and temporal relationships, then representativeness to the general population should not be the goal. The goal should rather be to find generalizable results through generating knowledge of relationships and the mechanisms at work (Rothman et al., 2013).

Strengths and Limitations

The current thesis can report on several strengths. Different studies have previously investigated the occurrences of NLE (Walker et al., 2021), parenting (Miranda-Casas et al., 2007) and externalizing (Jensen & Steinhausen, 2015) and internalizing (Daviss, 2018) symptoms in ADHD compared with general population samples. Others have compared

ADHD cases with control groups (Biederman et al., 2008; Briscoe-Smith & Hinshaw, 2006). The current study replicates and extends on these findings by comparing results with the general population and case controls, derived from the general population sample. The current study is thus able to compare results from each method applied. In addition, it has been noted that there is a need for research on the longitudinal relationship between parenting and depression in ADHD (Deault, 2009). While some have studied the longitudinal relationships, for example between stress and depression (Phillips et al., 2015) or comparing depression in ADHD and non-ADHD (Biederman et al., 1996), the current study extends further on these findings by studying the temporal relationship between NLE, parenting and both conduct and depression in adolescents with ADHD compared with a matched control group.

There are, however, limitations in the current study, some of these relate to the method of measurements. It needs to be noted that there is no way to control for possible systematic differences between the participants the who received parental consent to participate and those who did not. When using self-report for diagnosis a possibility arises that not all with symptoms reaching the diagnostic criteria have been diagnosed. Those with comorbid symptoms are more likely to be diagnosed, due to higher referral rates when experiencing added amount of difficulty (McConaughy & Achenbach, 1994), a bias known as the Berkson's bias (Berkson, 1946). The NLE score used in the current study does not ask about physical, sexual, or mental abuse, violence, or neglect, and thus might not pick up on some of these potentially traumatizing stressful experiences. This would be a recommendation to include for further studies. In addition, a question could be included relating to whether a participant has a trauma diagnosis. The positive parenting style variable is calculated by adolescents' response on believed parental reaction to only two specific scenarios at both T1 and T2, which might be ambitious to generalize to be indicative of all parenting situations. Conduct scores were dependent on the adolescent's self-report, ultimately it would be beneficial to have a teacher and /or parents' responses on the perceived conduct difficulties of the adolescents as well. Dichotomizing the variables for depression might create lower statistical power in this variable (Royston et al., 2006). However, the dichotomizing has been done to alleviate skewedness in responses, making it more appropriate for use in SEM analysis (StataCorp., 2021). It is a strength that the dichotomized categories are based on established severity categories for the level of symptom presentation (Burdzovic Andreas & Brunborg, 2017). The low response rate on the depression variable made it difficult to use this variable, as the reason for high attrition on this scale in the questionnaire is unknown. However, it is a strength in the current study, that attrition and response rate is controlled for

and commented on, which is often lacking in previous studies comparing ADHD to a general population.

There are also some limitations in the methods used. For example, there may have been other variables to match on (for example, parenting education or family history of depression). Also, attrition at T2 appeared disproportionate for the ADHD cases, reducing the already small sample size. The results are thus important to view as explorative and future research needs to address attrition and its correlates. Even with these limitations, the current thesis contributes to the knowledge on difference between ADHD and non-ADHD adolescents in occurrence of, and the temporal associations between, NLE, parenting and externalizing and internalizing comorbidities, and it contributes by exploring different methods of comparisons.

Clinical Implications and Recommendation for Future Research

Adolescents with ADHD do experience more symptoms of conduct difficulties and depression compared to their non-ADHD diagnosed peers, even compared with peers who are exactly matched on 6 demographic and health covariates. In addition, the current thesis support evidence of adolescents with ADHD experiencing significantly less positive parenting as well as less stable parenting style over time, compared to both the general population and a matched control group. This is significant as we simultaneously have found that more positive parenting is associated with less symptoms of depression a year later for adolescents with ADHD. For adolescents with ADHD, special focus should be made on improving their interactions with their parents and in their homelife, to ensure a stable and safe environment which can alleviate some of the negative effects of having ADHD. Adolescents with ADHD also presented greater life history of NLE, both compared to the general population and to case controls. The accumulation of factors of stress do indicate greater risk for the adolescents with ADHD, which to avoid later adverse effects, should be a focus for prevention. Finding that using exact matching eliminated the difference in NLE experienced by the adolescent with ADHD compared to the general population, indicate that in the composition of the 6 covariates controlled for, might be risk factors for experiencing more NLE. These risk factors should be paid attention to in attempts to understanding and hopefully prevent accumulation of NLE in Norwegian adolescents.

In future studies of occurrences of and temporal relationships between the test factors in ADHD compared to non-ADHD, it is recommended to use a high-risk sampling strategy to gather as many ADHD diagnosed participants as possible, rather than using a general

population sample. A larger ADHD recruited group could compensate for missing data in comparisons and longitudinal analysis or allow for examination of possible characteristics associated with dropout or for use of more advanced missing-data techniques. Further research into the non-random attrition currently found in the ADHD sample may also be useful for future longitudinal studies. Future research should include both symptoms' scales and self-reporting related to the diagnosis of ADHD, to detect how many may be under-diagnosed. This can also allow for research on differences between those reaching diagnostic criteria's who are or are not diagnosed. To further assess the effect of environmental stressors versus genetic influence, data from parents, such as parental ADHD or parental depression, should be attempted collected and controlled for as well. Further research into differences between ADHD and non-ADHD groups in the temporal associations of the factors in interest, could benefit from looking at a general population path model as well as using a case control for multi-group comparisons. This could provide information on the normative paths between the studied factors. Special focus should be made into further investigation on the effect currently found of the instability of both parenting style and NLEs experienced by the adolescents with ADHD.

Conclusion

When comparing analytical methods, we found that using a matched control sample yielded less robust, but seemingly more accurate, differences between the groups. To gain statistical power in the future, high-risk sampling is recommended. Adolescents with ADHD are, even when compared to a matched control, still found to experience more challenges than their peers. Comparing adolescents with ADHD with a matched control group on temporal associations over 1 year, show significant differences between the groups. Adolescents with ADHD experience less stability in parenting practices and life experiences than their matched peers. Indeed, there was no significant stability between the constructs at the two timepoints for the ADHD group. Conduct was for adolescents with ADHD less influenced by NLE which might indicate a stronger genetic risk for conduct problems. Depression was in adolescents with ADHD more influenced by positive parenting. Parenting style was overall, for adolescents with ADHD, more influential than NLE on symptoms of conduct problems and depression.

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Appendix A: Correlation Matrixes

Table A1.

Correlation Coefficients of covariates for the full MyLife Sample.

	ADHD	Gender	Grade attending	Parents living together	Immigrant status	Dyslexia	Standard of living
ADHD	1.00						
Gender	-.019	1.00					
Grade attending	.016	-.01	1.00				
Parents living together	-.077***	-.024	-.009	1.00			
Immigrant status	.0004	-.022	-.026	.014	1.00		
Dyslexia	.163***	-.024	.045*	-.006	-.025	1.00	
Standard of living	.014	.014	-.039*	.018	-.007	.015	1.00

Notes: ADHD and dyslexia as self-reported diagnosis; grade as a measure of age; immigrant status based on language spoken at home; standard of living based on communal level; * = p value <.05, ** = p value <.01, *** = p value <.001

Table A2.

Correlation matrix for ADHD and the test variables for the full MyLife Sample

	ADHD	NLE life	NLE 1	NLE 2	PHQ1	PHQ2	Cond. 1	Cond. 2	Pos par 1	Pos par 2
ADHD	1.00									
NLE life	.093***	1.00								
NLE 1	.072***	.19***	1.00							
NLE 2	.0615**	.28***	.42***	1.00						
PHQ1	.11***	.26***	.45***	.36***	1.00					
PHQ2	.02	.24***	.31***	.48***	.57***	1.00				
Cond. 1	.08***	.15***	.26***	.22***	.32***	.20***	1.00			
Cond. 2	.06**	.12***	.17***	.30***	.20***	.30***	.47***	1.00		
PosPar1	-.098***	-.07***	-.12***	-.10***	-.20***	-.12***	-.25***	-.16***	1.00	
PosPar2	-.05**	-.09***	-.09***	-.16***	-.14***	-.17***	-.14***	-.20***	.34***	1.00

Notes: NLE= negative life events; PHQ-9= measurement for symptoms of depression; Cond.= conduct difficulties; Pos.Par= positive parenting; * = p value <.05, ** = p value <.01, *** = p value <.001; f= a trend, not significant but p under .10.

Table A3.*Correlation matrix for the test variables for ADHD case group*

	NLE life	NLE 1	NLE 2	PHQ1	PHQ2	Cond.1	Cond2	Pos.Par1	Pos.Par2
NLE life	1.00								
NLE 1	-.09	1.00							
NLE 2	.19	.21 ^f	1.00						
PHQ1	-.02	.41***	.27*	1.00					
PHQ2	.07	.04	.46***	.43***	1.00				
Cond.1	-.06	.35***	.21 ^f	.51***	.25*	1.00			
Cond.2	-.05	.07	.07	.27*	.33**	.51***	1.00		
Pos.Par1	-.23*	.13	-.30*	-.15	-.46***	-.24*	-.21	1.00	
Pos.Par2	-.23 ^f	.01	-.36**	-.16	-.37**	-.14	-.13	.29*	1.00

Notes: NLE= negative life events; PHQ-9= measurement for symptoms of depression; Cond.= conduct difficulties; Pos.Par= positive parenting; * = p value <.05, ** = p value <.01, *** = p value <.001; ^f= a trend, not significant but p under .10.

Table A4.*Correlation matrix for the test variables for matched control group*

	NLE life	NLE 1	NLE 2	PHQ1	PHQ2	Cond.1	Cond2	Pos.Par1	Pos.Par2
NLE life	1.00								
NLE 1	.06	1.00							
NLE 2	.06	.26*	1.00						
PHQ1	.002	.58***	.35**	1.00					
PHQ2	.24*	.29**	.34**	.50***	1.00				
Cond.1	.17	.06	.02	.16	.12	1.00			
Cond.2	.05	.26*	.26*	.26*	.42***	.42***	1.00		
Pos.Par1	.12	-.26*	-.02	-.27*	.12	-.21 ^f	-.11	1.00	
Pos.Par2	-.08	-.22*	-.02	-.15	-.008	-.12	-.25*	.30**	1.00

Notes: NLE= negative life events; PHQ-9= measurement for symptoms of depression; Cond.= conduct difficulties; Pos.Par= positive parenting; * = p value <.05, ** = p value <.01, *** = p value <.001; ^f= a trend, not significant but p under .10.

Appendix B: Measurements and Scales

Negative Life Events

At year 1 (T1) participants were asked whether they have experienced any of the below questions during the last 12 months, or ever before (life history). At year 2 (T2) the participants were asked only about the last 12 months.

1. Mother died.
2. Father died.
3. Someone in my closest family got severely ill or died.
4. My parents moved apart.
5. We have moved to a new home.
6. Mother got a new partner or remarried.
7. Father got a new partner or remarried.
8. The adults at home fought a lot.
9. Farther or mother lost their job.
10. My family had money issues.
11. I was called ugly names or kept outside at internet or social media
12. I had issues with my weight or my looks.
13. One of my best friends do not want to be with me anymore.
14. I was called ugly things or kept outside at school.
15. I was bullied.
16. I moved away from home.

The adolescents were asked the questions in Norwegian: T1: Har du opplevd noe av dette? Marker om du har opplevd det i løpet av de siste 12 månedene, og/eller om du har opplevd det tidligere, eller ikke i det hele tatt. T2: Har du opplevd noe av dette i løpet av de siste 12 månedene?

1. Vi har flyttet inn i ny bolig
2. En i den nærmeste familien min ble alvorlig syk eller døde
3. Foreldrene mine flyttet fra hverandre
4. Mor døde
5. Far døde
6. Mor fikk ny samboer eller giftet seg på nytt
7. Far fikk ny samboer eller giftet seg på nytt
8. De voksne hjemme kranglet mye
9. Far eller mor mistet jobben
10. Familien min hadde pengeproblemer
11. Jeg ble kalt stygge ting eller ble holdt utenfor på internett/sosiale medier
12. Jeg hadde problemer med vekten eller utseende mitt
13. En av mine beste venner vil ikke være sammen med meg mer
14. Jeg ble kalt stygge ting eller ble holdt utenfor på skolen
15. Jeg ble mobbet
16. Jeg flyttet hjemmefra

Parenting Style

The parenting style variable is based on 2 questions asked. The responses to the two questions give an indication of the level of positive parenting the adolescents perceive to receive from their parents. The participants were asked about how likely it was that their parents would react with “discussing it in a calm matter” in the two scenarios:

1. What do you think your parents would do if you spent too much time on social media or gaming?
2. What do you think your parents would do if you were out too late at night without a good reason?

The likelihood of the “discuss it in a calm matter” reaction was measured on a 5-point likert scale. The options in the likert scale are:

1. Definitely not (scored as 1)
2. Probably not (scored as 2)
3. Don't know (scored as 2.5)
4. Probably so (scored as 3)
5. Definitely so (scored as 4)

The adolescents were asked the questions in Norwegian: Spørsmålene som ble stilt til ungdommene var hvor ofte foreldrene dere ville «diskutere det på en rolig måte» i de følgende scenarioene:

1. Hva tror du foreldrene dine ville gjort hvis du brukte for mye tid på sosiale medier eller spill?
2. Hva tror du foreldrene dine ville gjort hvis du var for lenge ute om kvelden uten god grunn?

Svaralternativene på hvordan foreldrene ville «diskutere det på en rolig måte», var en 5 punkts likart skala:

1. Helt sikkert ikke
2. Ganske sikkert ikke
3. Vet ikke
4. Ganske sikkert
5. Helt sikkert

Conduct difficulties

Regarding the participants conduct there were 9 questions asking about the last 12 months. The answer alternatives were 1: never, 2: once or twice, 3: three or four times, 4: 5 or more times. How often:

1. Did you destroy something on purpose which did not belong to you?
2. Lie to your parents or guardians about where you had been or who you were with?
3. Get in a serious fight?
4. Was out all night without your parents knowing where you were?
5. Stole something valuable from others?
6. Behave publicly in a way considered “bråkete, bølllete eller pøbelaktig”?
7. Got hurt or was exposed to an accident so that you needed medical attention?
8. Was exposed to violence which gave you visible marks or injuries?

9. Bullied others?

The adolescents were asked the questions in Norwegian: Med svaralternativene 1: aldri, 2: 1 eller 2 ganger, 3: 3 eller 4 ganger og 4: 5 ganger eller mer, ble ungdommene spurt disse spørsmålene. Tenk på de siste 12 månedene, hvor ofte:

1. Ødela du med vilje noe som ikke tilhørte deg?
2. Løy du for dine foreldre eller foresatte om hvor du hadde vært eller hvem du var sammen med?
3. Havnet du i en alvorlig slåsskamp?
4. Var du borte en hel natt uten at foreldrene dine visste hvor du var?
5. Stjal du noe verdifullt fra andre?
6. Oppførte du deg bråkete, bøllete eller pøbelaktig på offentlig sted?
7. Ble du skadet/utsatt for en ulykke slik at du trengte legehjelp?
8. Ble du utsatt for vold som ga synlige merker eller skader?
9. Mobbet du andre?

Symptoms of Depression

To measure symptoms of depression, the Patient Health Questionnaire 9 (PHQ-9) was used. The PHQ-9 asks 9 questions, listed below. The participant is asked to think about the last two weeks when they answer and respond with the answer alternatives: 1: not at all, 2: some days, 3: more than half of the days, 4: almost every day.

1. Feeling down, depressed, irritable, or hopeless
2. Little interest or pleasure in doing things
3. Trouble falling asleep, staying asleep, or sleeping too much
4. Poor appetite, weight loss, or overeating
5. Feeling tired, or having little energy
6. Feeling bad about yourself, or that you're a failure or that you've let yourself or your family down
7. Trouble concentrating on things like schoolwork, reading, or watching TV
8. Moving or speaking so slow that other people could have noticed
9. Thought that you would be better off dead, or of hurting yourself in some way

The adolescents were asked the questions in Norwegian: Hvor ofte har du vært plaget av de følgende tingene i løpet av de siste 2 ukene? Med svaralternativene 1: ikke i det hele tatt, 2: noen dager, 3: mer enn halvparten av dagene, 4: nesten hver dag.

1. Følt deg nedfor, nedtrykt, irritabel eller håpløs?
2. Lite interesse eller lyst til å gjøre ting?
3. Problemer med å få sove, å sove lenge nok, eller å sove for mye?
4. Dårlig appetitt, gått ned i vekt, eller overspising?
5. Følt deg trøtt eller hatt lite krefter?
6. Hatt dårlige følelser om deg selv- eller følt deg mislykket, eller at du har skuffet deg selv eller familien din?
7. Problemer med å konsentrere deg om slikt som skolearbeid, lesing eller å se på TV?
8. Beveget deg eller snakket så tregt at andre personer kunne ha lagt merke til det, eller det motsatte – vært så urolig at du har beveget deg mye mer enn vanlig?
9. Tenkt at du heller burde ha vært død, eller tenkt på å skade deg selv på en eller annen måte