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Introduction

Liam (12 years) had been struggling with severe Obsessive-Compulsive Disorder (OCD) for several years. After starting therapy, he was showing signs of improvement. According to Liam, he felt he was making excellent progress. He managed to reduce his handwashing rituals from every hour to three times a day and had started joining some family meals. He was also beginning to meet his friends for short walks around the neighborhood. However, his parents observed a different reality. While Liam had made some progress, he often became trapped in lengthy rituals that caused him significant distress. He had yet to return to school full time, attending only partial days if he went at all. Though he started venturing out with friends, it was only to familiar, controlled environments. The family had rearranged the house to facilitate his progress—stocking rooms with hand sanitizers and scheduling regular therapist meetings to help him during challenging times. His parents continued to monitor his progress closely, supporting him in his journey while remaining aware of the continuous obstacles that his OCD presented.

This vignette demonstrates the importance of recognizing that the child's perspective is distinct, but equally valid. Traditionally, clinicians have relied on parents to provide sufficient information about the effects of illness and treatment on their child. However, the insights gathered could significantly differ depending on whether the information comes from Liam or his mother, whether the objective is clinical assessment or research. From this evaluation, we must make clear how parent and child assessments of mental health relate to one another. Additionally, mental health problems can vary across different contexts (Bauducco et al., 2024; Beesdo et al., 2009). Children and adolescents may exhibit mental health concerns in certain environments, such as at home or school, while appearing unaffected in others, like during peer interactions. These contextual variations are evident across various domains, including conduct problems, attention, hyperactivity, and anxiety (Jónsdóttir et al., 2022). Consequently, the source of information—whether from self, parents, other family members, healthcare professionals, or teachers—can lead to differing perceptions and understandings of the child's condition.

Traditionally, in both clinical and research work, the assumption that adults can answer for children has gone unchallenged. Children have been seen to be unreliable respondents, who lack the linguistic and cognitive skills required to understand and respond to questionnaires. In many cases it may well be that children are too young or ill to complete questionnaires themselves. In some circumstances, there may be no alternative but to rely on proxy raters. Advocates of measures which rely exclusively on adults as informants argue that these may better facilitate assessments of children across the age range, compared with multiple measures designed for child self-report at different age levels [1]. Against this, relying on an adult as informant may result in incomplete assessment to the extent that the child's subjective experience and perceptions of HRQoL may be overlooked. (Eiser & Morse, 2001)

This divergence in perspectives introduces complexities into clinical practice, research, and theory regarding child psychiatry and psychopathology(Chen et al., 2017; Salbach-Andrae et al., 2009). These differences have been thoroughly examined and will be covered in more detail below (Van Roy et al., 2010). Furthermore, while the use of multiple informants in mental health assessment is thought to enhance our understanding of the psychological functioning of children, particularly in the infant population, we are still in the process of discovering how to effectively utilize this wealth of information (Reyes, 2013).

Informant Discrepancies

The issue of informant discrepancies is particularly pertinent when interpreting study findings in the field of developmental psychopathology. A significant portion of the evidence about prevalence rates of psychological disorders, classification of diagnosis, effectiveness of interventions for children is derived from reports by multiple informants (Weisz et al., 2005). For example, the prevalence rates of conduct and oppositional defiant disorders in community samples range from 1.6% to 10.2%, depending on whether parent or teacher ratings are relied on to classify disorder in the child or whether both are considered simultaneously (Offord et al., 1996). Prevalence of classification of disorder ranges widely in clinic samples as well. When relying on parent or teacher ratings, or combining information from both, prevalence of conduct disorder ranges from 9.7% to 23%, and emotional disorder (anxiety, depression) ranges from 10.3% to 36.2% (MacLeod et al., 1999) (De Los Reyes & Kazdin, 2005). Furthermore, depending on the informant, it is typical to find inconsistent results from controlled studies evaluating psychological therapies (De Los Reyes & Kazdin, 2005). Understanding these discrepancies is crucial for accurately assessing intervention outcomes and advancing research in developmental psychopathology.

The phenomenon of informant discrepancy has been recognized for nearly 70 years, dating back to Lapouse and Monk's work in 1958. Achenbach, McConaughy, and Howell (1987) conducted a seminal analysis of 119 studies investigating these informant inconsistencies. Their key findings included: (a) reports of the same behavior by different informants generally show low to moderate agreement; (b) the reports of two informants observing children in the same setting are more similar than those of two informants observing children in different settings; (c) there is greater agreement between informants' reports for younger children compared to older ones; and (d) reports of externalizing behaviors like aggression show higher consistency than those of internalizing behaviors such as anxiety. They concluded by stating, "Different informants are needed for different situations. . . there is no royal road or preeminent gold standard for phenomena that are inevitably affected by assessment procedures and other situational variables" (p. 227–228). Consequently, the primary objectives of the informant discrepancies research summarized by Achenbach et al. (1987) were to outline the extent of informant discrepancies, identify the informant pairs (e.g., parent and child, teacher and parent) with the greatest discrepancies, and pinpoint the behavioral domains where these discrepancies were most pronounced.

Research conducted since 1987 has primarily focused on understanding the characteristics associated with informant discrepancies, potential biases in informants' reports, and the impact these discrepancies have on the conclusions drawn from research studies. (Reyes, 2013)

Regarding children, it's possible that the particular domains being taken into consideration affect how accurate proxy ratings are. Therefore, gathering information about a child’s functioning typically involves input from multiple informants (Achenbach, 2006).

Furthermore, studies in the 1970s indicated that girls tend to be more reliable informants than boys [14]. (Caqueo-Urízar et al., 2022)

Additionally, there are certain contextual factors that associate with higher agreement or discrepancy between reports. It has been observed that when there is a higher socioeconomic level, parents tend to underestimate the problems related to their children’s mental health, while in lower socioeconomic levels, the opposite happens [22]. Furthermore, family factors, such as parenting style, lack of communication, and conflict between parents and children, have been associated with higher levels of discrepancy in both reports [23–32], while family cohesion and parental acceptance have shown fewer discrepancies [9,25]. Traditionally, these observed differences have been interpreted as a function of measurement errors and informant bias [26]. However, such discrepancies may be significant to understand the nature and course of child and adolescent psychopathology, as they may reflect underlying family problems, which potentially contribute to the development of psychopathologies [27]. (Caqueo-Urízar et al., 2022)

Parent Rating

Moreover, when externalized problems are analyzed, it seems that parents tend to be more precise than their children; however, when internalized symptoms are analyzed, there seems to be less agreement about which group reports symptoms better [15]. This disagreement stems from the fact that children value their behavior more positively than parents do [10]; although, it becomes more complicated towards adolescence, where they seem to report poorer health than parents, especially in emotional health [16]. Various studies support that these discrepancies are based on an underestimation of anxious and depressive symptoms by the parents [17–20]. (Caqueo-Urízar et al., 2022)

However, when externalizing symptoms such as defiant behavior or hyperactivity are under evaluation, some studies have found a higher level of agreement between both groups [9,21]. (Caqueo-Urízar et al., 2022)

In that sense, a meta-analysis carried out by Los Reyes et al. [4] including 341 studies published between 1989 and 2014, observed low-to-moderate correspondence between children’s self-report and parents’ report (mean internalizing: r = 0.25; mean externalizing: r = 0.30; mean overall: r = 0.28). (Caqueo-Urízar et al., 2022)

Research indicates discrepancies and varying accuracy in symptom reporting, with no clear consensus. Child reports internalized symptoms more accurately, while parents tend to be more precise in identifying externalized (Silverman & Eisen, 1992).

However, the reliability of parent reports for assessing children's experiences, especially for non-observable functions like emotions, has been questioned (Eiser & Morse, 2001). Parental assessments often differ from children’s self-perceptions, potentially due to biases, superficial observations, or the nature of the parent-child relationship. Conversely, children frequently lack objective self-perception (Barrett et al., 1991; Martin et al., 2004).

Agreement as a test of validity for multiple informant

It can be challenging for clinicians to make a diagnosis if data from different sources are conflicting. When assessing children’s behavioral and emotional problems, informants tend to disagree [30,31]. Disagreement between children and their parents about target problems can be problematic when it comes to setting treatment goals, which can, ultimately, lead to poorer treatment outcomes [35]. Studying moderators of parent–youth agreement may facilitate diagnostic processes [36]. Research suggests that agreement between parents and children is related to factors such as a child’s age [31,35], gender [37,38] and type and severity of disorder – especially anxiety and depression [39] – and parental psychopathology [39–42]. Studying those moderators may guide clinicians in assessing which reports have greater veracity [35,42,43]. (Jónsdóttir et al., 2022)

MRI

Voxel based morphometry

Meta-analyses of voxelbased morphometry (VBM) studies have found altered volumes in frontal and striatal regions, and in a broader range of structures, including parietal and limbic brain areas.3,4 A recent VBM mega-analysis on pooled raw magnetic resonance imaging (MRI) data from our multisite OCD Brain Imaging Consortium (OBIC), revealed significantly smaller volumes of frontal grey matter and white matter bilaterally, as well as group6age interactions in frontostriatal and limbic regions.5 Of particular interest in the meta-analyses and VBM mega-analysis is the finding of decreased grey matter volume in the dorsomedial prefrontal cortex,6,7 a region responsible for performance monitoring and emotional processing, processes which are affected in OCD.8 (Fouche et al., 2017)

Although we performed a VBM analysis on this data previously, other techniques such as surface-based methods can provide complementary information. Whereas VBM measures grey matter volume or density, surface-based methods such as FreeSurfer can calculate morphometric attributes in the native space of the participant, and allow a determination of cortical thickness.9

In addition, segmentation in VBM is suboptimal for some subcortical areas, such as pallidum and thalamus, because of the lack of clear grey–white contrast of these structures.

In recent years, magnetic resonance imaging (MRI) studies have provided numerous evidence of functional and structural abnormalities in various brain regions in OCD, mainly within the cortico-striato-thalamo-cortical (CSTC) circuit [8–12] (Hu et al., 2017). The success of neuroimaging in revealing the neural correlates of OCD has raised hopes of using MRI indices to discriminate OCD patients and the healthy.

volume of gray matter (VGM), cortical thickness and sulcal depth were extracted from T1-weighted images as the structural neuroimaging markers.

These MRI indices were used because previous studies have successfully revealed altered VGM [34–36] and cortical thickness [37–39] in various brain regions, including the traditional CSTC circuit and newly reported regions, such as the occipital, parietal, and temporal lobes and the cerebellum, in patients with OCD. sulcal depth may provide valuable information for classification since previous studies indicate the association of altered sulcus morphology and psychotic disease [40–42].

It is also important to explain the contribution of the MRI markers when constructing the OCD diagnosis models. However, due to the “black box” problem of machine learning models, such as SVM, previous studies seldom explored the contribution of the MRI markers used in the classification models. The Shapley value is a fair profit allocation among many stakeholders depending on their contribution and was derived from the name of the economist who introduced it. By using the idea of the Shapley value, approaches were proposed to interpret the predictions from any “black box” model [49, 50]. The key component of general explanations is the contributions (equivalent to the Shapley value) of individual input features. A prediction is explained by assigning to each feature a number which denote its influence. For each feature, such contributions can be aggregated to plot the feature’s average contribution against the feature’s value. This provides an overview of the model and explanation of the predictions.(Huang et al., 2023)

the ultimate conclusions drawn from this empirical work and thus recommendations to researchers and practitioners mirror those that Achenbach et al. (1987) provided over 25 years ago. In other words, recent empirical work echoes findings long known from prior meta-analytic reviews, begging the question, Have 25 years of empirical work on informant discrepancies improved how researchers and practitioners conduct multi-informant assessments? (Reyes, 2013)

Machine Learning

Obsessive-Compulsive Disorder

OCD is unique among mental illnesses in that it exhibits both externalizing and internalizing symptoms (Guzick et al., 2019). Externalizing features, like compulsivity and repetitive actions, are often outwardly disruptive and align with disorders such as attention-deficit/hyperactivity disorder (ADHD) and disruptive behavior disorders. In contrast, internalizing aspects, including anxiety, concerns, and obsessions, cause internal distress and align with conditions like depressive and anxiety disorders, often leading to avoidance or withdrawal (Achenbach, 2001). Understanding OCD within this dual framework enhances our grasp of its complexity and informs more effective therapeutic strategies. These frameworks are not only therapeutically beneficial but are also supported by empirical research (Kessler et al., 2011; Slade & Watson, 2006). OCD is recognized as a prevalent and persistent neuropsychiatric condition, impacting an estimated 2% to 3% of individuals worldwide (de Mathis et al., 2013). The disorder commonly arises in early life and is characterized by the presence of compulsions – ritualized behavioral or mental acts, and obsessions – intrusive and unwanted thoughts and worries (Karno et al., 1988).

The present study

Research question: To what extent does structural brain data explain the variation in anxiety symptoms as reported by youths versus their parents?

Model building focus on a phenomena that is already well established to see whether machine learning can detect the same features of informer discrepancy on ABCD dataset

Use MRI to predict youth score vs. parent score on four dimensions.

Have difference in score as an independent variable.

Hypothesis

There will be a significant difference in the prediction accuracy of structural brain data between self-reported and parent-reported anxiety symptoms in adolescents with GAD, with an expectation of higher accuracy for self-reported symptoms.

The purpose of this study was to examine agreement between youths and their parents regarding psychiatric problems, at a symptom level, using the CBCL. There are certain limitations of measuring parent–child agreement using the diagnostic approach, such as the loss of information (e.g. severity or magnitude of disagreement) when data are dichotomized. Another approach is to measure symptom agreement, which would make a quantitative distinction between parent’s and child’s ratings [26]. Thus, we will also examine agreement at a symptom level using the Achenbach System of Empirically Based Assessment (ASEBA) in an Icelandic outpatient clinical sample, as well as studying the influence of age, gender, attention-deficit/ hyperactivity, anxiety disorder and depressive disorder on parent–youth agreement. (Jónsdóttir et al., 2022)

Methods

Sample

* OCD scores by race/ethnicity
* post distributions: internalizing children vs parents and externalizing children vs parents
  + age, sex, socio economic

Clinical characteristics:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Characteristic  N (%) | Full Sample  (10756) | OCD absent  (10068) | OCD present  (662) | Group difference | Effect size |
| **KSADs Lifetime diagnosis** | | | | | |
| Any depressive disorder | 44(0.41%) | 35(0.35%) | 9(1.36%) | =13.19 | OR= |
| Any anxiety disorder | 286(2.66%) | 191(1.90%) | 95(14.35%) | =366.34 | OR= |
| ADHD | 635(5.90%) | 516(5.13%) | 119 (17.98%) | =181.75 | OR= |
| ODD/CD | 630(5.86%) | 523(5.19%) | 107(16.16%) | =133.24 | OR= |
| Bipolar | 228(2.12%) | 148(1.47%) | 80 (12.08%) | =331.43 | OR= |
| Drug use disorder | 26(0.24%) | 19(0.19%) | 7 (1.06%) | =15.96 | OR= |
| Any suicidality | 345(3.21%) | 271(2.69%) | 74(11.18%) | =141.05 | OR= |
| Any eating disorder | 118(1.10%) | 89(0.88%) | 29(4.38%) | =66.61 | OR= |
| No diagnosis | 9105(84.65%) | 8748(86.88%) | 357(53.93%) | =3114.60?? | OR= |
| **CBCL T-score** | | | | | |
| Mean (SD) | (10773) | (10733) | (660) |  |  |
| DSM-5 Anxiety | 53.37(5.92) | 52.94(5.36) | 59.81(9.21) |  |  |
| DSM-5 Depression | 53.76(5.94) | 53.43(5.62) | 58.91(8.00) |  |  |
| DSM-5 Somatic | 54.79(6.26) | 54.58(6.07) | 58.03(7.96) |  |  |
| DSM-5 ADHD | 53.10(5.33) | 52.84(5.09) | 57.06(7.13) |  |  |
| DSM-5 Opposite | 53.04(5.03) | 52.85(4.83) | 55.96(6.91) |  |  |
| DSM-5  Conduct | 52.39(4.80) | 52.21(4.57) | 55.04(6.88) |  |  |
| OCD | 53.30(5.72) | 52.82(5.03) | 60.68(9.38) |  |  |
| Total problem score | 44.64(11.41) | 43.92(11.11) | 55.60(10.26) |  |  |

\*NA = adhd=6, depressive disorder = 4, anxiety = 4, eating disorder = 4, no diagnosis =4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Comorbidities | OCD absent | OCD present | Group diff | Effect size |
| No (other) diagnosis | 8748 | 357 |  |  |
| 1 | 962 | 174 |  |  |
| 2 | 257 | 76 |  |  |
|  | 95 | 55 |  |  |

Demographic characteristics:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Characteristic | Full sample  (10711) | OCD absent  (10049) | OCD present  (662) | Group difference | Effect size |
| Age | 9.48(0.51) | 9.48(0.51) | 9.46(0.50) |  |  |
| Sex, Female | 5096(47.58%) | 4777(47.54%) | 319(48.19%) |  |  |
| Pubertal status, Female | 3.28(0.80) | 3.28(0.81) | 3.25(0.76) |  |  |
| Pubertal status, Male | 2.01(0.91) | 2.00(0.91) | 2.09(0.88) |  |  |
| Perinatal | 0.0029(0.91) |  |  |  |  |
| Race, white | 5746(53.65%) | 5415(53.89%) | 331(50.00%) |  |  |
| Race, hispanic | 2098(19.59%) | 1970(19.60%) | 128(19.34%) |  |  |
| Parental marital status, married | 7227(67.47%) | 6838(68.05%) | 389(58.76%) |  |  |
| Parental education |  |  |  |  |  |
| Parental income | 7.53(2.32) | 7.57(2.29) | 6.99(2.63) |  |  |
| General SES | 0.00(0.94) |  | -0.26 |  |  |
| Social functioning | 0.0027(0.85) |  |  |  |  |
| NIH toolbox – cognition total |  |  |  |  |  |
| Family conflict – child report |  |  |  |  |  |
| Family conflict – parent report |  |  |  |  |  |
| Usable structural data | 7969 | 7495 | 474 |  |  |

SES, social functioning, perinatal variables are zero-centered; pubertal status is a 5-point scale,

Itemwise CBCL OCS characterization:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CBCL OCS item | Score | Full sample  (10898) | | OCD absent (10048) | |  | OCD present (660) | |
| 9- cannot get his/her mind off certain thoughts; obsessions | 0 | 8264(75.83%) | 7890(78.52%) | | 239(36.21%) | | |
| 1 | 2198(20.17%) | 1854(18.45%) | | 304(46.06%) | | |
| 2 | 436(4.00%) | 304(3.03%) | | 117(17.73%) | | |
| 31- feels he/she might think or do something bad | 0 | 10177(93.38%) | 9492(94.47%) | | 516(78.18%) | | |
| 1 | 654(6.00%) | 514(5.12%) | | 121(18.34%) | | |
| 2 | 66(0.61%) | 42(0.42%) | | 23(3.48%) | | |
| 32- feels he/she has to be perfect | 0 | 7993(73.34%) | 7511(74.75%) | | 347(52.58%) | | |
|  | 1 | 2484(22.79%) | 2210(21.99%) | | 226(34.24%) | | |
|  | 2 | 420(3.85%) | 327(3.25%) | | 87(13.18%) | | |
| 52- feels too guilty | 0 | 10226(93.83%) | 9518(94.73%) | | 532(80.61%) | | |
|  | 1 | 609(5.59%) | 487(4.85%) | | 109(16.52%) | | |
|  | 2 | 62(0.57%) | 43(0.43%) | | 19(2.88%) | | |
| 66- Repeats certain acts over and over: compulsions | 0 | 10293(94.45%) | 9692(96.46%) | | 432(65.45%) | | |
| 1 | 508(4.66%) | 313(3.12%) | | 181(27.42%) | | |
| 2 | 96(0.88%) | 43(0.43%) | | 47(7.12%) | | |
| 84- Strange behavior | 0 | 10472(96.09%) | 9741(96.94%) | | 553(83.79%) | | |
| 1 | 391(3.59%) | 285(2.84%) | | 97(14.70%) | | |
| 2 | 34(0.32% | 22(0.22%) | | 10(1.16%) | | |
| 85- strange ideas | 0 | 10313(94.63% | 9593(95.47%) | | 545(82.58%) | | |
|  | 1 | 559(5.13%) | 440(4.38%) | | 106(16.06%) | | |
|  | 2 | 25(0.23%) | 15(0.15%) | | 9(1.36%) | | |
| 112- worries | 0 | 7434(68.21%) | 7060(70.26%) | | 244(36.97%) | | |
|  | 1 | 3009(27.61%) | 2666(26.53%) | | 293(44.39%) | | |
|  | 2 | 454(4.17%) | 322(3.20%) | | 123(18.64%) | | |
| OCS score >0 |  | 5764(52.89%) | 5085(50.62%) | | 574(86.97%) | | |
| OCS score >1 |  | 3330(30.56%) | 2781(27.68%) | | 476(72.12%) | | |
| OCS score 5 |  | 621(5.70%) | 401(3.99%) | | 206(31.21) | | |
| CBCL OCS sum |  | 1.25 | 1.10 | | 3.50 | | |
| CBCL OCS t-score |  | 51.87 | 51.64 | | 55.24 | | |

Comparison parent vs child reports (CBCL):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Parent | | | Child | | |
|  | Full Sample | OCD absent | OCD present | Full Sample | OCD absent | OCD Present |
| Attention | 53.52(5.65) | 53.23(5.34 | 57.92(7.95) | 56.20(6.95) | 56.06(6.89) | 58.26(7.50) |
| Internal | 47.66(10.52) | 47.01(10.19) | 57.62(10.44) | 53.41(5.31) | 53.27(5.30) | 55.48(6.63) |
| External | 44.38(9.83) | 43.92(9.578) | 51.29(10.91) | 52.10(4.27) | 52.03(4.19) | 53.05(5.29) |
| Total problem score | 44.64(11.41) | 43.92(11.11) | 55.60(10.26) | 53.70(5.64) | 53.57(5.53) | 55.87(6.83) |

Study Design

The Adolescent Brain and Cognitive Development (ABCD) Study is a decade-long investigation in the US, tracking children from ages 9-10 through late adolescence and early adulthood. This study conducts annual lab-based evaluations and biannual imaging scans to assess various mental and physical health metrics (Saragosa-Harris et al., 2022; Barch et al., 2018). The ABCD Study is designed to enhance our understanding of the behavioral, genetic, neurobiological, and environmental factors influencing health and risk factors for physical and mental health issues. It includes 12,000 children at baseline, recruited from 21 research sites across the United States (Karcher & Barch, 2021). The study contains neuroimaging, cognitive assessments, psychosocial surveys, and hormonal measurements. To ensure the cohort is diverse and representative, the ABCD Study employs a multi-stage probability sampling technique, along with weighting methods and stratified sampling within specific regions to minimize selection bias.

See below for list of used questionnaires:

|  |  |  |
| --- | --- | --- |
| **Mental Health Assessment** | | |
| Construct | Measure | Citations |
| ***Parent about Youth/Family*** | | |
| Categorical Psychopathology and Suicide/ Homicidally | Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS-5) | (Kaufman & Birmaher, 2013; K. A. Kobak et al., 2013; K. Kobak & Kaufman, 2015) |
| Dimensional Psychopathology/Adaptive Function | Achenbach Child Behavior Check List | (Achenbach, 2009) |
| History of Mental Health and Substance Abuse Services | Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia | (K. Kobak & Kaufman, 2015) |

|  |  |  |
| --- | --- | --- |
| **Demographic Assessment** | | |
| Construct | Measure | Citations |
| ***Parent about Youth/Self/Family*** | | |
| Parent/Guardian Age, Birth Sex, Gender Identity, Race, and Ethnicity | PhenX | (Stover et al., 2010) |
| Child Age, Birth Sex, Gender Identity, Race, and Ethnicity | PhenX | (Stover et al., 2010) |
| Country of Origin for Grandparents, Parent/Guardian and Child | PhenX | (Stover et al., 2010) |
| Parent/Guardian Education, Occupation and Current Income | PhenX | (Stover et al., 2010) |
| Family Income | PhenX | (Stover et al., 2010) |
| School performance, repeating a grade, detention/suspensions and a drop in grades, special services | Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia | (K. A. Kobak et al., 2013) |
| Bullying and youth friendships | Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia | (K. A. Kobak et al., 2013) |
| ***Youth about Self*** | | |
| Repeating a grade, detention/suspensions and a drop in grades | Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia | (K. A. Kobak et al., 2013) |
| Friendships | # of same and different gender friends | NA |

Data acquisition

DSM-5 Schedule for Affective Disorders and Schizophrenia for School-Aged Children – Present and Lifetime Version (K-SADS-PL) The K-SADS-PL DSM-5 is a semi-structured interview for children and adolescents aged 6–18 years, as well as their parents. It was revised in 2016 to be compatible with DSM-5 diagnosis [44]. Diagnoses can be classified as ‘not present,’ ‘possible,’ ‘in remission’ or ‘certain’. In this study, diagnoses were based on symptoms classified as certain only. In a previous study, the inter-rater reliability of the Icelandic DSM-5 K-SADS (using different raters than in the current study) ranged from fair to excellent (0.57–0.90), with most diagnoses in the excellent range (0.75) [45].(Jónsdóttir et al., 2022)

ASEBA – Achenbach System and Empirically Based Assessment The Child Behavior Checklist (CBCL) for ages 6–18 [46] is a 120-item, parent-rated questionnaire designed to assess children’s social competence and mental health problems. The equivalent self-rated questionnaire is The Youth SelfReport (YSR) for ages 11–18 [46]. Items on the two lists are rated on a 0–2 rating scale: 0 1⁄4 not true; 1 1⁄4 somewhat or sometimes true; 2 1⁄4 very or often true. Achenbach et al. [47] constructed a new scoring system for the CBCL and YSR scales, based on the DSM diagnostic criteria, the DSM-oriented scales, which will be used in the current study. The scales are: affective problems, anxiety problems, ADHD problems, oppositional defiant problems, conduct problems (CD) and OCD problems [48]. For this study, the internal consistency for CBCL was a1⁄4.81 for affective problems, a1⁄4.76 for anxiety, a1⁄4.84 for ADHD, a1⁄4.84 for ODD, a1⁄4.87 for CD, and a1⁄4.56 for OCD. The internal consistency for YSR was a1⁄4.86 for affective problems, a1⁄4.85 for anxiety, a1⁄4.78 for ADHD, a1⁄4.68 for ODD, a1⁄4.88 for CD, and a1⁄4.80 for OCD. (Jónsdóttir et al., 2022)

Methods and materials

**Participants**

All participants were originally recruited as part of the Adolescent Brain Cognitive

Development (ABCD) study currently ongoing in the US. The review and approval of the

ABCD research protocol was handled by a central Institutional Review Board at the

University of San Diego, California (Auchter et al., 2018), and the study follows established

federal and state regulations regarding biomedical ethics in the U.S. (Clark et al., 2018).

Informed consent was given by parents or guardians and assent was given by children before

participation. While the initial goal of the ABCD study was to assess substance use, it evolved

into a longitudinal cooperative developmental study which tracks children from ages ~10-20

and contains a wide range of data on observable phenotypes (Volkow et al., 2018). A total of

11,877 participants between the ages of 9 and 10.99 years were included at baseline (ABCD

4.0 Data Release, 2022), recruited from 21 data collection sites across the US, representing a

wide range of socioeconomic strata. Participants had to be able to complete all baseline

measurements, including MRI scanning, to participate. Exclusion criteria from the ABCD

study include sensorimotor impairments, persistent major neurological disorders, severely

premature birth, birthweight of less than 1200 grams, current diagnosis of psychiatric

disorder, and traumatic brain injury. For the present study, participants will have a varying

amount of MRI- and neurocognitive data due to exclusions based on quality control and task

responses across the two timepoints. An overview of the final sample is displayed in table 1.

See data acquisition for further elaborations on participant exclusions.(INA)

**Data acquisition**

Data for the present study was specifically collected from the ABCD release 4.0 (doi:

10.15154/1523041), with the exception of MRI data from the two-year follow up obtained

from the ABCD fast-track imaging data release (see https://abcdstudy.org/scientists/data-

sharing/fast-track-imaging-data-release/). My access to the data material was granted through

Request #7474 (PI: Westlye), and local approval for handling of data is registered as REK

2019/943 (Regional Committees for Medical and Health Research Ethics). All data handling

was performed on the TSD (Tjeneste for Sensitive Data) facilities, a secure server

environment owned by the University of Oslo.

*Structural MRI*

Participants were scanned at 21 data collection sites across the US, acquiring structural

T1w images from a total of 28 different scanner types from Siemens, General Electric (GE)

and Philips (ABCD Data Release 4.0, 2022). Images from Siemens scanners were obtained

with 176 slices, TE: 2.88 ms, and acquisition time: 7:12. Philips scanners had the following

parameters: 225 slices, TE: 2.9 ms, and acquisition time: 5:38. Finally, images obtained from

GE scanners had 208 slices, TE: 2, and acquisition time: 6:09. All scanners shared a14

resolution of 1.0 x 1.0 x 1.0. and a TR of 2500 ms for the T1w images. Due to a large amount

of missing MRI data from the 2-year follow up, unprocessed images from this timepoint were

obtained from the ABCD Fast-track Imaging Data Release. Here, several participants had

more than one T1w image, likely due to movement by the participant causing insufficient

image quality. Images for each of these participants were matched with - and selected based

on timestamps documented in an additional file provided by ABCD regarding subsequent

quality control. Participants were excluded from a timepoint if the T1w data did not meet all

criteria for inclusion, as recommended by ABCD (ABCD Data Release 4.0, 2022). Further

exclusions were made if the data did not pass the initial post processing quality control. (INA)

**MRI data acquisition**

Image processing and analysis methods corresponding to ABCD Release 2.0.1 are described Hagler et al., 2019, NeuroImage. Image processing and analysis methods for the Adolescent Brain Cognitive Development Study (doi: [10.1016/j.neuroimage.2019.116091](https://doi.org/10.1016/j.neuroimage.2019.116091)). Changes to image processing and analysis methods in Release 3.0 and Release 4.0 are documented below. No significant changes were made to the processing pipeline for Release 5.0.

https://wiki.abcdstudy.org/release-notes/imaging/structural-mri.html

From caregiver and youth perspective, information is obtained about both current and lifetime mental health diagnoses of the youth using a validated and computerized Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS) for DSM-5 (KSADS-COMP), developed by Dr. Joan Kaufman and Dr. Ken Kobak with NIH Small Business Innovation Research support (Kobak et al., 2013; Kobak and Kaufman, 2015). This is a self-administered, computerized version that does not involve a clinician for either the caregiver or the youth, though the youth are supported in completing the KSADS-COMP by trained research assistants. In Section 3.2 below, we provide more information about changes in this measure over assessment waves and known issues or considerations in the use of data from the KSADS-COMP (Barch et al., 2021)

Statistical analyses/Preliminary analyses(?)

Modelling approach(?)

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