



Review

Demographic, physical and mental health assessments in the adolescent brain and cognitive development study: Rationale and description

Deanna M. Barch^{a,*}, Matthew D. Albaugh^b, Shelli Avenevoli^c, Linda Chang^d, Duncan B. Clark^e, Meyer D. Glantz^f, James J. Hudziak^g, Terry L. Jernigan^h, Susan F. Tapertⁱ, Debbie Yurgelun-Todd^j, Nelly Alia-Klein^k, Alexandra S. Potter^l, Martin P. Paulus^m, Devin Proutyⁿ, Robert A. Zucker^o, Kenneth J. Sher^p

^a Departments of Psychological & Brain Sciences and Psychiatry, Washington University, Box 1125, One Brookings Drive, St. Louis, MO 63130, United States

^b Department of Psychiatry, University of Vermont College of Medicine, Mail Stop 446 AR6, 1 South Prospect Street, Burlington, VT 05401, United States

^c National Institute of Mental Health, National Institutes of Health, 6001 Executive Blvd, Bethesda, MD 20892, United States

^d Chang Department of Radiology, University of Maryland School of Medicine, 419 W. Redwood Street, Suite 225, Baltimore, MD 21201, United States

^e Department of Psychiatry, University of Pittsburgh, 3811 O'Hara Street, Pittsburgh, PA 15215, United States

^f Department of Epidemiology, Services, and Prevention Research, National Institute on Drug Abuse, National Institutes of Health, Bethesda, MD 20892, United States

^g Department of Psychiatry, University of Vermont College of Medicine, St. Joe's Room 3213, Box 364SJ, 1 South Prospect, Burlington, VT 05401, United States

^h Departments of Cognitive Science, Psychiatry & Radiology, University of California at San Diego, 9500 Gilman Drive (0603), La Jolla, CA 92093-0603, United States

ⁱ Department of Psychiatry, University of California at San Diego, 9500 Gilman Drive (0603), La Jolla, CA 92093-0603, United States

^j Department of Psychiatry, University of Utah School of Medicine, 501 Chipeta Way, Salt Lake City, UT 84108, United States

^k Department of Psychiatry, Icahn School of Medicine at Mount Sinai, Friedman Brain Institute, 1470 Madison Avenue, New York, NY 10029, United States

^l Department of Psychiatry, University of Vermont College of Medicine, 1 South Prospect Street Arnold 6, Burlington, VT 05401, United States

^m Laureate Institute for Brain Research, 6655 South Yale Ave, Tulsa, OK 74136-3326, United States

ⁿ Center for Health Sciences, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, United States

^o Department of Psychiatry & Addiction Center, University of Michigan, Rachel UpJohn Building, 4250 Plymouth Road, Ann Arbor, MI 48109-2700, United States

^p Department of Psychological Sciences, University of Missouri, 200 South Seventh Street, Columbia, MO 65211, United States

ARTICLE INFO

Keywords:

Psychopathology
Assessment
Physical health
Mental health

ABSTRACT

The Adolescent Brain and Cognitive Development (ABCD) Study incorporates a comprehensive range of measures assessing predictors and outcomes related to both mental and physical health across childhood and adolescence. The workgroup developed a battery that would assess a comprehensive range of domains that address study aims while minimizing participant and family burden. We review the major considerations that went into deciding what constructs to cover in the demographics, physical health and mental health domains, as well as the process of selecting measures, piloting and refining the originally proposed battery. We present a description of the baseline battery, as well as the six-month interim assessments and the one-year follow-up assessments. This battery includes assessments from the perspectives of both the parent and the target youth, as well as teacher reports. This battery will provide a foundational baseline assessment of the youth's current function so as to permit characterization of stability and change in key domains over time. The findings from this battery will also be utilized to identify both resilience markers that predict healthy development and risk factors for later adverse outcomes in physical health, mental health, and substance use and abuse.

1. Introduction

As described in the opening paper in this Special Issue, the Adolescent Brain and Cognitive Development (ABCD) Study is a large and unprecedented study of youth that will inform our understanding of

the environmental, genetic, neurobiological, and behavioral factors that promote health and which put youth at risk for both physical and mental health problems. As described in the opening paper, this study is designed to run for at least 10 years, following youth recruited at age 9 and 10 into late adolescence/early adulthood. The ABCD study will

* Corresponding author at: Couch Chair of Psychiatry, Washington University in St. Louis., Box 1125, One Brookings Drive, St. Louis, MO, 63130, United States.

E-mail addresses: dbarch@wustl.edu (D.M. Barch), matthew.albaugh@med.uvm.edu (M.D. Albaugh), avenevoli@mail.nih.gov (S. Avenevoli), lchang@hawaii.edu (L. Chang), clarkdb@upmc.edu (D.B. Clark), mglantz@nida.nih.gov (M.D. Glantz), james.hudziak@med.uvm.edu (J.J. Hudziak), tjernigan@ucsd.edu (T.L. Jernigan), stapert@ucsd.edu (S.F. Tapert), deborah.yurgelun-todd@hsc.utah.edu (D. Yurgelun-Todd), nelly.alia-klein@mssm.edu (N. Alia-Klein), alexandra.potter@uvm.edu (A.S. Potter), mpaulus@laureateinstitute.org (M.P. Paulus), devin.prouty@sri.com (D. Prouty), zuckerra@med.umich.edu (R.A. Zucker), SherK@missouri.edu (K.J. Sher).

<http://dx.doi.org/10.1016/j.dcn.2017.10.010>

Received 18 March 2017; Received in revised form 10 September 2017; Accepted 30 October 2017

Available online 03 November 2017

1878-9293/ © 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

collect a wide variety of data on each youth, as described in the other papers in this issue, including imaging data, biomarkers (e.g., hormones, DNA), cognitive function, substance use and abuse, and measures of the youth's family and environment. Importantly, the ABCD study incorporates a broad range of measures assessing predictors and outcomes related to both mental health and physical health in children and later in adolescence and young adulthood. The workgroup on mental and physical health assessment strove to develop a battery that would address a range of domains within the time constraints imposed by the need to capture the many different types of data described in the other articles included in this Special Issue. Here we review the major considerations that went into deciding what domains to cover in the mental and physical health battery and the process of selecting measures, as well as the piloting and refining of the originally proposed battery. We provide a description of the final baseline battery, the 6-month interim assessments and the one-year follow-up battery. Given that the data being collected as part of the ABCD study will be widely accessible to the scientific community, we hope that this description will be of use to the field by making clear what measures are available for assessing mental and physical health in the study participants, so that such measures can be related to the other assessments of brain structure and function, biomarkers, cognition, environment, and substance use in the same youth. Further, we hope that this information will be informative for researchers who are deciding which measures of similar constructs to include in their own studies.

2. Considerations shaping the choice of the baseline instruments

A number of different considerations went into both the choice of domains and the selection of measures for the baseline mental and physical health battery. In terms of domains, a first major consideration was to cover the domains explicitly requested by the Request for Applications (<https://grants.nih.gov/grants/guide/rfa-files/RFA-DA-15-014.html>), which asked for assessment of a broad range of mental health and physical health related constructs, both as starting point evaluations that establish a baseline from which to assess changes, and as indicators of change or outcome. The choice of constructs to be assessed was also influenced by extant data in the literature as to the constructs that would be important for understanding both healthy brain development and risk for substance use and risk behavior. Another set of considerations related to the developmental stage of the sample. Assessments designed to collect data from parents about their children needed to be appropriate for reports about 9- and 10-year-old children. Assessments designed to collect data from the youth needed to be appropriate for use with 9- and 10-year old children. As such, for youth, the reading level needed to be age-appropriate and the concepts assessed needed to be ones that children would be able to understand. At the same time, we also needed measures that would “stand the test of time” in a longitudinal study. Thus, they needed either to be measures that could feasibly be used through early adulthood, or measures that had parallel versions that were appropriate for older ages. Further, the battery needed to focus on measures where the responses would not become invalid as measures of the constructs of interest due to repeated assessments or practice effects. In this way ABCD will be able to validly map stability and change for relevant phenotypes of interest across child, adolescent, and young adult development (i.e., homotypic continuity) as well as chart the progression of different phenotypes that are nonetheless related over the course of development (heterotypic continuity) (Kagan and Moss, 1962; Rutter et al., 2006).

A further consideration was that the assessments needed to be feasible and reliable for use in this large sample with multiple sites and many assessors. Thus, the selected measures needed to comprise a short and standardized assessment amenable for use in a computerized battery that would permit either easy administration by a research assistant or self-administration by the youth or parent. Another important consideration was the availability of strong psychometric evidence for

Table 1
Members of the ABCD Physical and Mental Health Assessment Workgroup.

Name	Role	Institution
Deanna M. Barch	Chair	Washington University in St. Louis
Kenneth Sher	Co-Chair	University of Missouri at Columbia
Mathew Albaugh	Member	University of Vermont
Nelly Alia-Klein	Member	Mount Sinai School of Medicine
Ruben Alvarez	Member	National Institute of Child Health and Human Development
Shelli Avenevoli	Member	National Institute of Mental Health
Dara Blachman-Demner	Member	Office of Behavioral and Social Sciences Research
Linda Chang	Member	University of Maryland Baltimore
Duncan Clark	Member	University of Pittsburgh Medical School
Ian Colrain	Member	Stanford Research Institute
Meyer Glantz	Member	National Institute on Drug Abuse
Rebekah S. Huber	Member	University of Utah
James J. Hudziak	Member	University of Vermont
Margie Hernandez Mejia	Member	University of California at San Diego
Carrie Mulford	Member	United States Department of Justice
Yunsoo Park	Member	United States Department of Justice
Martin Paulus	Member	Laureate Institute
Alexandra Potter	Member	University of Vermont
Devin Prouty	Member	Stanford Research Institute
Susan Tapert	Member	University of California at San Diego
Deborah Yurgelun-Todd	Member	University of Utah
Robert Zucker	Member	University of Michigan

scale reliability and validity. Where possible, we chose measures that were also being used in other large-scale studies, so as to support the possibility of harmonization across studies and/or independent replication. A corollary of this last consideration was that where possible, we chose measures that had been recommended as common data elements by the PhenX initiative (Stover et al., 2010; Hamilton et al., 2011; Maiese et al., 2013; McCarty et al., 2014) or other NIH assessment initiatives (Conway et al., 2014; Barch et al., 2016). All prospective studies run the risk of selecting measures and methods that are state-of-the-art when launched, but in hindsight look anachronistic ...”the danger that 20 years later one is stuck with what could prove to be dated and trivial data” (Mednick and McNeil 1968) In ABCD, we believe that the range of constructs assessed, attention to developmental factors, use of multiple informants, use of both dimensional and categorical measures, and attention to psychometric properties mitigate this type of threat inherent to long-term prospective studies.

3. Workgroup and development process

The composition of the ABCD Mental and Physical Health workgroup is shown in Table 1 and consists of members from many of the participating sites, as well as scientific and program officers from ABCD Federal Collaborators. We met by teleconference weekly during the development of the battery and met as needed to evaluate the pilot data and refine the initial battery. We continue to meet to review the accumulating data, and to plan for follow-up batteries. This committee nominated and selected measures to assess the constructs of interest based on reviewing the literature, documented scale reliability and validity, and consulted with other experts about their experiences in recent or ongoing studies. In addition, before piloting, we sent the proposed battery to a number of experts in the field who were not involved in ABCD for feedback about the proposed measures and constructs, and made additional modifications based on this input. The initial baseline battery proposed by the group is shown in Tables 2–4. This battery was evaluated by the ABCD external advisory committee and then piloted across sites in children and their parents. Piloting indicated that the combined battery was longer than we believed was feasible for the planned study, especially the protocol to be administered to the children. Consequently, we shortened the mental and physical health battery, particularly the components for the children. In

Table 2
Demographics, Socioeconomic Status, and Additional Questions About School and Friendships.

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)
Child Religious Preference	PhenX	Stover et al. (2010)
Parent/Guardian Education, Occupation and Current Income	PhenX	Stover et al. (2010)
Family Income	PhenX	Stover et al. (2010)
Household Composition	Household Roster Questionnaire from the General Social Survey, also in Phenx	Smith et al. (2015)
Economic Insecurity	Best Practices in Conceptualizing and Measuring Social Class in Psychological Research	Diemer et al. (2012)
School performance, repeating a grade, detention/suspensions and a drop in grades, special services	Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia	(Kobak et al., 2013)
Bullying and youth friendships	Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia	Kobak et al. (2013)
Youth about Self		
Child Sexual Orientation and Gender Identity	Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia	Kobak et al. (2013)
Repeating a grade, detention/suspensions and a drop in grades	Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia	Kobak et al. (2013)
Friendships	# of same and different gender friends	NA

doing so, we focused on eliminating measures of constructs that we thought could validly be assessed by parent report at this age or where there was redundancy across measures or across items within a measure. When this shortening involved modification of an existing measure, we describe the changes below in the description of the particular measures.

4. Description of measures

Below we describe the specific measures that were included in the initial pilot battery, the final battery, or both, organized by primary domain (physical health then mental health) and by reporter (parent then youth) within each domain. For each measure, we describe what it was designed to measure and why this is relevant to the study. We describe why the particular measure was chosen, and the rationale for and description of any modifications that we made to the measure. Lastly, we briefly summarize the types of information or scores that can be derived from the measure. The tables that accompany this section

outline the duration of each assessment component.

4.1. Demographics, socioeconomic status, school performance, and friendships

It is critical to obtain thorough demographic information about youth and their families, given the key role that environmental factors play in shaping the health and development of children and adolescents and to accurately characterize the study sample. Thus, the battery includes an extensive demographic questionnaire composed primarily of items and questions from the PhenX toolkit, as shown in Table 2. This includes information about the parent/guardian participating with the youth, the parent/guardian’s partner (which could be the youth’s other parent), and information about the youth’s grandparents (e.g., country of origin). We ask about family income and household composition using questions from the General Social Survey (Smith et al., 2015), in order to assess income-to-needs and overall income. The level of income relative to the number of individuals in the household may be a more

Table 3
Baseline Physical Health Battery.

Construct	Measure	~Time	Citations
Parent about Youth			
Developmental History	Developmental History Questionnaire	15 min	Kessler et al., (2009a,b), Merikangas et al., (2009)
Medical History and Health Services Utilization	Magic Health Services Utilization Questionnaire	10 min	Todd et al. (2003)
Current Medications	Medication Inventory from Phenx	5 min	NHLBI (2000)
Brain Injury/Concussion	Modified Ohio State University TBI Screen-Short Version	5 min	Corrigan and Bogner (2007), Bogner et al., (2017)
Sleep Function	Sleep Disturbances Scale for Children	5 min	Bruni et al. (1996), Spruyt and Gozal (2011)
Visual Media Usage	Screen Time Questionnaire for Parent [modified from existing questionnaires in the literature]	1 min	Sharif et al. (2010)
Involvement in Sports and Other Activity	Sports and Activities Involvement Questionnaire [modified from the Vermont Health Behavior Questionnaire]	10 min	Huppertz et al. (2016)
Pubertal Status	Pubertal Development Scale	7 min	Petersen et al. (1988)
Youth about Self			
Exercise	Exercise questions from the Youth Risk Behavior Survey	2 min	CDC (2016)
Height, Weight, BMI, Waist Circumference	Height, Weight, BMI, and Waist Circumference from National Health and Nutrition Examination Survey (also in PhenX)	5 min	CDC Division of Nutrition (2016)
Electronic Device Usage & Mature-rated Video Games and Movies	Screen Time Questionnaire for Child [modified from existing questionnaires in the literature]	3 min	Sharif et al. (2010), Hull et al. (2014)
Pubertal Status	Pubertal Development Scale	3 min	Petersen et al. (1988)

Table 4
Baseline Mental Health Battery.

Construct	Measure	~Time	Citations
Parent about Youth/Family			
Categorical Psychopathology and Suicide/Homicidally	Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS-5)	35 min	Kaufman et al., (2013), Kobak et al. (2013), Kobak and Kaufman (2015)
Dimensional Psychopathology/Adaptive Function	Achenbach Child Behavior Check List	10 min	Achenbach (2009)
Mania Symptoms	Parent General Behavior Inventory 10 item Mania Scale	5 min	Youngstrom et al. (2008)
History of Mental Health and Substance Abuse Services	Introduction to Kiddie Schedule for Affective Disorder and Schizophrenia	NA	Kobak and Kaufman (2015)
Youth about Self			
Categorical Psychopathology and Suicide	Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS-5) [Mood Disorders (minus sex questions), Separation Anxiety Disorder, Social Anxiety Disorder, Generalized Anxiety Disorder, Sleep Problems, Suicidality]	15 min	Kaufman et al. (2013), Kobak et al. (2013), Kobak and Kaufman (2015)
Psychosis	Pediatric Psychosis Questionnaire – Brief Version	8 min	Loewy et al. (2005), Loewy et al. (2011), Loewy et al. (2012)
Impulsivity	Modified UPPS-P for Children from PhenX	3 min	Zapolski et al. (2010), Lynam (2013)
Behavioral Inhibition & Activation	Child Behavioral Inhibition & Behavioral Activation Scales from PhenX	3 min	Carver and White (1994), Pagliaccio et al. (2016)
Parent About Self and Family			
Dimensional Psychopathology/Adaptive Function	Achenbach Adult Self Report Questionnaire	10 min	(Achenbach, 2009)
Family History of Psychopathology	Modification of the Family History Assessment from NCANDA	15 min	Brown et al. (2015)
Teacher About Youth			
Dimensional Psychopathology/Adaptive Function	Achenbach Brief Problem Monitor	5 min	Achenbach (2009)

sensitive assessment of socioeconomic influences (McLoyd, 1998) than income alone. In addition, we assess a number of other indicators of economic insecurity that have been recommended as best practice measures that provide additional information about socioeconomic influences (Diemer et al., 2012). We assess information about friendships and bullying from both the parent's and the youth's perspectives, as friendship quantity and quality may be both an early indicator of interpersonal function and a predictor of later outcome. We ask parent and youth for information about the youth's function in school, including questions about repeating a grade, detention/suspensions, and school performance. School performance may serve either as another early indicator of challenges or as a predictor of future resilience or impairment. Lastly, we also ask the youth about their gender identity and sexual orientation (Table 2). In future years, at developmentally appropriate timepoints, we will ask further information about dimensional measures of gender identity that move further beyond the gender binary as well as more dimensional and/or polytomous measures of sexual orientation. We will also ask further questions about sexual identity, gender dysphoria, and gender roles and behavior at future developmentally appropriate timepoints, starting with the 1 year follow-up battery.

4.2. Physical health and related individual difference constructs

4.2.1. Parent report

4.2.1.1. Developmental history questionnaire. Events and experiences that occurred either when the youth was *in utero* or throughout the course of their early development may either be indicators of early risk outcomes (delay in developmental milestones), or predictors of later outcomes (e.g., maternal substance use during pregnancy, birth trauma, etc.). Thus, the parent assessment battery includes a developmental history questionnaire that was originally developed by the Adolescent Component of the National Comorbidity Survey (Kessler et al., 2009a,b; Merikangas et al., 2009) with some additional supplemental questions on maternal use of substances during pregnancy (see Table 3). This questionnaire covers maternal prenatal care, maternal substance use during pregnancy (including caffeine and tobacco), prenatal maternal health conditions (e.g., gestational diabetes), prematurity, birth complications, and developmental milestones. This assessment is

completed at the baseline initial assessment only.

4.2.1.2. Medical history. The youth's medical history establishes a baseline of health status for study participants, allowing researchers to measure health trends throughout the course of the study. This information may also reveal potential risk or protective factors for healthy psychological and brain development. Thus, the parent assessment battery includes a medical history questionnaire about the youth. The questionnaire was derived from the MAGIC Health Services Utilization Questionnaire (Todd et al., 2003). At baseline, the questionnaire covers both past year and lifetime conditions, and includes both illness and injuries. As described below, we will ask the parent to update the youth's medical history at each in-person follow-up assessment.

4.2.1.3. Medication inventory. It is important to assess the youth's current medication regime in order to examine potential correlations between medication use throughout the course of the study and subsequent child and adolescent growth and development. Further, current medications could also have an impact on the other assessments in the battery (e.g., functional connectivity or activation) and may provide additional information about mental and physical health related issues. Thus, the parent assessment battery includes a Medication Inventory, obtained from the PhenX Toolkit October 1, 2015 Ver. 13.0 (NHLBI 2000). In order to enhance accuracy of medication assessment, the parent is asked to bring all of the youth's prescriptions to the in-person assessment. The parent then answers three questions that ask about prescription and over-the-counter medication(s) and caffeinated drink consumptions. It also documents any medication that the youth might have used within the past two weeks of the study visit. As described below, we will ask the parent to report on the youth's current medications at each in-person follow-up assessment.

4.2.1.4. Brain injury/concussion. The past ten years have seen increasing concern about the potential for concussion and head injury in children, particularly incidents occurring through children's participation in both structured and unstructured sports and other forms of physical activity. Such head injuries can have a variety of

consequences, including reduced school performance and increased risk for physical and mental health related problems (Corwin et al., 2014; Virji-Babul et al., 2014; Ellis et al., 2015). Thus, we ask the parent to report on the youth's lifetime history of concussions and other forms of head injury using the Modified Ohio State University TBI Screen – Short Version (Corrigan and Bogner 2007; Bogner et al., 2017). This questionnaire is designed to assess lifetime history of traumatic brain injury (TBI) in the youth. It queries parents to recall events related to the occurrence of TBI (e.g. falling on ice, being hospitalized after an injury to the head or neck). A positive response to an occurrence question is followed up with questions to determine loss of consciousness, memory loss, and other details about the event. Summary indices can be derived to assess the number, severity, timing, and effects of lifetime TBI events. At the initial baseline assessment we ask about the youth's entire life. As described below, at follow-up assessments we will ask the parent to report on any new concussion or head-related injuries that may have occurred since the youth's previous assessment. The reliability of the parent report version has not been assessed to our knowledge, but the reliability of the self-report version in adults has been moderate to high in prior studies (Corrigan and Bogner 2007), with test-retest ICCs ranging from 0.76 to 0.87 (Bogner et al., 2017).

4.2.1.5. Sleep function. From late childhood to late adolescence, profound changes occur in sleep timing and architecture (Baker et al., 2016). In studying adolescent brain and cognitive development, assessments of sleep constructs can identify sleep disturbances (Bruni et al., 1996) and measure sleep patterns and circadian preference variations that may be potential risks for subsequent substance use and psychopathology (Hasler et al., 2016). Assessment of sleep function can also establish a baseline for later determining the influence of substance use and other exposures on subsequent sleep disruptions (Hasler et al., 2014). While optimal methods may include objective measures such as polysomnography collected in the sleep laboratory and activity monitoring (de Zambotti et al., 2015), we were limited to questionnaire assessments feasible to include in the baseline ABCD assessment.

While options for measuring sleep disturbances include questionnaires administered to children themselves, most childhood measures utilize parental proxy responses (Spruyt and Gozal 2011; Ji and Liu 2016). We selected the Sleep Disturbance Scale for Children (SDSC) for its validity for this age period, comprehensive screening for a variety of sleep disturbance types, and brevity. Developed and validated for school aged children and adolescents, the SDSC (Bruni et al., 1996; Ferreira et al., 2009) is a 26-item Likert-type rating scale administered to a parent. The six scales are: (1) disorders of initiating and maintaining sleep; (2) sleep breathing disorders; (3) disorders of arousal or nightmares; (4) sleep wake transition disorders; (5) disorders of excessive somnolence; and (6) sleep hyperhydrosis. It has shown reasonable test-retest reliability ($r = .71$ for total score) over a period of 28–46 days (Bruni et al., 1996).

As described below, at follow-up assessments we will ask the parent to report again on the youth's sleep function. Further, as the ABCD sample reaches adolescence, the assessment of sleep characteristics will increasingly shift to relying on the youth's assessment rather than parental report. More specifically, other sleep-related constructs that will be considered for future assessments include sleep patterns, sleep hygiene, daytime sleepiness, and circadian tendency (Ji and Liu 2016). Circadian disturbances have been hypothesized to disrupt adolescent functioning of reward-related brain systems that may influence mood disorders and substance use involvement (Hasler and Clark 2013). A number of these may be captured by an ambulatory assessment approach in future assessment periods.

4.2.1.6. Visual media use. There is great interest in the relationship between a youth's use of various electronic devices for video games, as

well as other “screen time” activities, and current and subsequent mental health and school performance (Kremer et al., 2014; van Rooij et al., 2014; Segev et al., 2015; Mejia et al., 2016; Nuyens et al., 2016; Schou Andreassen et al., 2016). For example, prospective longitudinal research shows that greater visual media use is indirectly related to subsequent poor school performance through links to increased sensation seeking, substance use, and problem behaviors in school. To assess this construct, we developed a brief assessment obtaining parent's report of their youth's use of visual media based on the work of Sharif, Wills and Sargent (Sharif et al., 2010). This measure includes two questions on the overall amount of time that the youth spends using visual media, one about a typical weekday and one about a typical weekend day. At follow-up assessments, we will ask the parent to report on the youth's visual media use at each in-person session.

4.2.1.7. Involvement in sports and activities. Youth involvement in various types of activities, including sports, music related activities, or hobbies, may benefit their mental and physical health outcomes, serving as protective factors for later problem behavior or substance abuse (Kirkcaldy et al., 2002; Bohnert and Garber 2007; McClure et al., 2010; Snyder et al., 2010; Taliaferro et al., 2011; Dawson 2014; Jewett et al., 2014; Kremer et al., 2014; Dolenc 2015; Godfrey et al., 2015; Vella et al., 2016). Thus, the parent battery includes an extensive assessment of the youth's lifetime involvement in a diverse range of activities. This baseline questionnaire for the initial assessment was modeled after the assessment developed for the Vermont Health and Behavioral Questionnaire (VHBQ) and the Dutch Health Behavioral Questionnaire (DHBQ) utilized in a number of U.S. and Dutch studies of health and wellness but expanded to include additional activities (Huppertz et al., 2016). It assesses both lifetime of history of involvement (yes/no for a variety of activities), frequency and duration of involvement during most intensive four-month period, whether the activity was part of an organized experience in school or out of school, and whether the youth has been involved in the activity during the past year. As described below, at follow-up assessments, parents will be asked to report on the youth's involvement in sports and activities since the last in-person assessment.

4.2.1.8. Pubertal status. The onset of puberty may be a critical time of emerging risk for a variety of mental health and substance-use-related outcomes and behaviors. Both earlier and later puberty have been associated with a range of problems (Kaltiala-Heino et al., 2003). Further, there is increasing evidence that pubertal status is related in important and interesting ways to brain structure and function. As described in the paper on biomarker assessment in ABCD (this issue), we will be assessing pubertal hormones in saliva in all children. A physician assessment of Tanner stage would also provide additional converging evidence, but was deemed impractical due to cost and time considerations. We are therefore measuring parent reports of pubertal status and menstrual status using the Pubertal Development Scale (Petersen et al., 1988). This is a brief measure used by numerous prior studies that has acceptable reliability and validity in US samples (Brooks-Gunn et al., 1987; Petersen et al., 1988). Unpublished work has reported a correlation of 0.80 between Tanner stage based on parent report and Tanner stage based on pediatrician evaluation (Miller et al., 1988). The inclusion of this measure will allow us to assess the converging validity of parent report and hormonal assays. As described below, we also ask youth to self-report on their pubertal status. Pubertal status evaluations will be completed at each in-person assessment.

4.2.2. Youth report

4.2.2.1. Exercise. The amount of physical exercise in which a youth engages may be an important predictor of brain development and both physical and mental health (Hillman et al., 2008). Thus, we assessed youth reported exercise using three items from the Youth Risk Behavior

Survey (YRB). The YRB is modified from the Youth Risk Behavior Survey, which is a standard questionnaire (89-item for High-school student, 49-items for middle school students) published by the Centers for Disease Control (CDC) bi-annually (CDC 2016). The youth will be asked to report on exercise again at each bi-annual assessment that involves neuroimaging (i.e., every two years).

4.2.2.2. Anthropometrics. Obesity is a major public health concern as rates of obesity have increased in children in recent years. Further, obesity related factors may be important predictors of physical and mental health. Thus, we use a set of standardized measurements used to help monitor health, obesity and growth in infancy through young adulthood (CDC Division of Nutrition 2016). Measurements include height, weight, body mass index, and waist circumference. These anthropometric measurements have been chosen to trend growth and physical development in adolescence through young adulthood over time. CDC guidelines are being used for the measurements in children. Anthropometrics will be assessed at each in-person session (i.e., yearly).

4.2.2.3. Visual media use and exposure to mature-themed media. As noted above in the description of the parent reported physical health assessment battery, there is strong interest in the relationship between a youth's use of visual media, including exposure to violent or adult themed media and both current and subsequent mental health and school performance. For example, more time spent playing "risk-glorifying" video games has been found to be associated with greater rates of subsequent risky driving habits, even after controlling for a host of factors that might also predict both exposure to risk-glorifying video games and risk behavior (Hull et al., 2014). We developed a brief assessment of youth's reported use of visual media based on the work of Sharif, Wills and Sargent (Sharif et al., 2010). This measure is similar to the parent report version, which includes two questions, in that it asks about visual media use on both a typical weekday and a typical weekend day. However, it is more extensive than the parent version in that it separates use time for different types of media (e.g. watching shows or movies, texting). Further, it also asks about the frequency of playing mature-rated video games and watching R-rated movies using questions derived from the work of Hull and colleagues (Hull et al., 2014). The youth will be asked to report visual media use and exposure to mature-themed media at each in-person assessment (i.e., every year). Preliminary analyses on the first 1167 ABCD participants indicate modest correlations between parent report of how much time the youth spends using media and the youth's own report, for both weekdays ($r = 0.23$) and weekend ($r = 0.30$). We will be able to address whether there is differential predictive utility of parent versus youth report over the course of the study as we acquire follow-up data on outcomes.

4.2.2.4. Pubertal status. As noted above, puberty is a time of emerging risk for both mental health and substance use related behaviors. Thus, the youth battery asks for self-reports of pubertal status using the Pubertal Development Scale (Petersen et al. 1988). This will allow us to assess the converging validity of youth report with both parent report of Tanner staging and salivary hormonal assay data. As noted below, the youth will be asked to self-report on pubertal status at each in-person assessment (i.e., yearly). In unpublished work, youth reports of mean puberty score (ages 8–13) have correlated between 0.47 and 0.82 with pediatrician reports, with variation in these correlations depending on youth's age (higher in older children) and gender (higher in girls) (Miller et al. 1988). Preliminary analyses on the first 1167 ABCD participants indicate reasonable correspondence between parent and youth reported mean puberty scores for males ($r = 0.48$), but less correspondence for females ($r = 0.19$). As the data on pubertal hormones become available, we will be able to assess the differential relationships of parent and youth report of pubertal status to such hormone data.

4.3. Youth mental health and related individual differences constructs

As specified in the request for applications for the ABCD project, the assessment of mental health includes both categorical and dimensional approaches (see Table 4). Further, because of the age of the youth at project entry, we include both youth self-reports and parent reports about the youth.

4.3.1. Parent report

4.3.1.1. Categorical assessments. The core of the categorical diagnostic assessment is the newly validated and computerized *Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS) for DSM-5 (KSADS-5)*, developed by Dr. Joan Kaufman and Dr. Ken Kobak with NIH SBIR support (Kobak et al., 2013). The KSADS has a long history of use as a reliable and valid measure of psychopathology in children and adolescents (Orvaschel et al. 1982; Chambers et al. 1985; Kaufman et al. 1997, 2000). In 2013, the KSADS was updated to assess DSM-5 diagnoses, and it is this version that has been translated into a computerized assessment (Kaufman et al. 2013). Dr. Kaufman and Dr. Kobak created three computerized versions: a traditional clinician administered version, a self-administered parent version (report on youth), and a self-administered youth version (report on self) (Kobak and Kaufman 2015). The self-administered computerized versions work well, with high concordance between current episode diagnoses using the computer self-administered KSADS-5 and clinician-administered paper-and-pencil version of the KSADS-5, with percent agreement in diagnostic categories ranging from 88%–96%, and kappas in the good to excellent range (Kobak et al. 2013). The use of a computerized assessment will allow easy database output and integration with the main ABCD database. The ABCD Mental and Physical Health Assessment Workgroup worked closely with the developers of the KSADS-5 to optimize the instrument for ABCD, which involved making several changes to the wording of some items, some tailoring of diagnostic algorithms (i.e., to allow past 12 month diagnoses), as well as the modularization of components to allow for more customization of each administration. Further, the KSADS-5 has also been translated into Spanish with the support of ABCD.

At baseline and likely for the next several longer bi-annual follow-ups that coincide with imaging, we have the parent complete almost all of the modules in the KSADS-5 (see Table 4), with the exception of the enuresis, encopresis and selective mutism modules for reasons of relevance to the goals of ABCD and time. Of note, traumatic experiences are assessed as part of the parent-report post-traumatic stress disorder module of the KSADS-5. See below for discussion of youth report on the KSADS-5. As described below, parent report on the KSADS-5 will be repeated at each in-person visit (i.e., yearly), but we will have the parents complete only the modules covering externalizing, psychosis, and eating disorders at the shorter bi-annual in-person assessments that will start with the year one follow-up. We chose to focus on externalizing, psychosis, and eating disorders at these shorter follow-ups given the evidence that parents are particularly important reporters for these behaviors in this age range, as compared to internalizing behaviors, where youth and parent report may start to diverge.

4.3.1.2. Dimensional assessments. We will ask the parents to report annually starting at baseline about the youth's behavior using the *Child Behavior Checklist (CBCL)* (Achenbach, 2009). In addition, as described below, we plan to collect youth self-report using the *Youth Self-Report (YSR)* (Achenbach, 2009) starting when the participant is age 12, and to also collect teacher reports using the *Brief Problem Monitor (BPM-T)*. The CBCL, YSR, and BPM-T are quantitative questionnaires that are normed by sex, age, informant and ethnicity. These same questionnaires have been used as phenotypic measures of normative brain-behavioral development correlations for anxiety, inattention, aggression, externalizing and internalizing behavior in the NIH Normal Brain Development study (Ducharme et al., 2011,

2012, 2015; Ameis et al., 2014; Albaugh et al., 2017). The forms are also used in the Generation R study of 10,000 typically developing Dutch Children who have been followed from birth and are currently the same age as the ABCD study population (Tiemeier et al., 2012). In Generation R, imaging, genomic and epigenomic data have all been collected and can be used for across study comparisons between the two studies (Ducharme et al., 2015). These computerized measures have been made available for free to the ABCD Consortium through the generosity of Thomas Achenbach. As described below, parents will be asked to complete CBCL at each in-person assessment (i.e., yearly).

4.3.1.3. Mania. Substance use disorders and bipolar disorder are frequently comorbid, although the mechanisms responsible for their co-occurrence remain unresolved (Strakowski and DelBello, 2000; Sherwood Brown et al., 2001; Levin and Hennessy, 2004). Moreover, there is clear evidence that heavy substance involvement complicates the course of bipolar disorder (Strakowski et al., 2000). Critically, this comorbidity is not limited to adulthood; evidence suggests that bipolar disorder in adolescence is associated with risk for the onset of substance use disorders and tobacco use and that this increased risk is not dependent upon co-occurring conduct disorder (Wilens et al., 1999; Wilens et al., 2008). Consequently, for those interested in the etiology of substance use disorders, symptoms of bipolar disorder represent an important risk domain to assess in youth. While bipolar disorder is one of the disorders assessed in the parent version of the KSADS-5, syndromal diagnosis may be relatively insensitive to lower-level symptomatology that, nonetheless, has etiological significance for early onset substance use and substance use disorders. Thus, we also assess dimensional mania symptoms (Sherwood Brown et al., 2001) using the ten-item Mania Scale (Youngstrom et al., 2008) derived from the 73-item Parent General Behavior Inventory (PGBI) for Children and Adolescents (Youngstrom et al., 2001), which itself is an adaptation of the adult form originally developed by Depue and colleagues (Depue et al., 1989). In deriving this short form, Youngstrom and colleagues identified the PGBI items that loaded on a factor largely composed of items reflecting hypomania and biphasic symptoms (i.e., reflecting bipolar variability in mood and behavior) and that best discriminated participants with and without bipolar spectrum diagnoses. The resulting 10-item scale correlated highly ($r = 0.95$) with the 28-item factor scale that reflected biphasic and manic symptoms, and had excellent internal consistency ($\alpha = 0.92$). Additionally, the ten-item Mania scale was able to discriminate among diagnostic groups with different mood disorders, ADHD, and unaffected youth. Thus, the Mania scale provides resolution of the relatively lower end bipolarity that is likely to be missed by syndromal diagnosis and provides a graded assessment of bipolarity that complements our other assessments in the psychopathology domain. As described below, parents will be asked to complete the 10-item Mania Scale at each in-person assessment (i.e., yearly).

4.3.2. Youth report

4.3.2.1. Categorical assessment

4.3.2.1.1. KSADS-5. The youth version of the KSADS-5 was originally conceived of as being used in children 12 and older. However, Dr. Kaufman's experience suggests that the youth version can work well in youth starting at age 9–10 if they have research assessment staff support (Kaufman, 2015, personal communication). Thus, we chose to also ask the youth to provide self-reports in selected mental health domains. We did this for three reasons. First, there is evidence that parent and youth report start to diverge in early adolescence (Grills and Ollendick, 2002; Fisher et al., 2006; Rockhill et al., 2007; Rothen et al., 2009), with some evidence for worse agreement for internalizing compared to externalizing disorders (Rey et al., 1992; Grills and Ollendick, 2002; Foley et al., 2004; Rothen et al., 2009), though not always (Verhulst and van der Ende 1992). Second, there is evidence that parent's own depression and anxiety can color

their reports of their children's level of depression and anxiety (Rothen et al., 2009). Third, there is also evidence that youth report may have predictive utility over and above parent report in at least some domains (Sourander et al., 2006a; Sourander et al., 2006b; Rothen et al., 2009). Based on the literature described above, we have children provide self-reports about mood disorders, separation anxiety, social anxiety, generalized anxiety, sleep and suicidality. We have trained the ABCD research assistants to support the youth in completion of the KSADS-5, with guidance from Dr. Kaufman and ongoing WEBEX trainings with both Dr. Deanna Barch and Dr. Sandra Brown. Of note, each site has a detailed protocol in place to address parent or youth reports of self-harm, suicidal ideation, or suicidal behavior. The KSADS-5 also provides an assessment of mental health treatment history as well as learning disability and other special education services. As described below, the youth will be asked to complete the suicidality section of the KSADS-5 at the shorter bi-annual in-person assessments that will start with the year one follow-up, but will not be asked to complete the other sections at these shorter assessments due to time constraints. However, in subsequent years, the youth will be asked to complete the additional modules on the KSADS-5 at the longer bi-annual assessments that include imaging, with the potential inclusion of additional KSADS-5 modules as is developmentally appropriate as the youth ages.

4.3.2.2. Dimensional assessments

4.3.2.2.1. Psychosis. Over the past ten years, the literature has seen much discussion and debate over the relationship between the onset of psychotic symptoms and cannabis use. The two countervailing positions are, on the one hand, that preclinical indicators of psychosis predispose individuals to cannabis use (Ksir and Hart, 2016), and, on the other hand, that cannabis use increases risk for psychosis (Kraan et al., 2016; Marconi et al., 2016; Levine et al., 2017). There is data from prospective studies to suggest that cannabis use maybe a risk factor for psychosis emergence (Marconi et al., 2016). However, further data to address this question are needed, developmental data on brain structure and function that might elucidate causal pathways. The psychosis assessment in the KSADS-5 focuses on diagnostic symptoms, and may miss the subtler prodromal psychosis risk phenotypes. The full range of diagnostic and prodromal psychosis phenotype indicators may be important in understanding this relationship vis-a-vis substance use predictors and outcomes. Thus, we are supplementing the parent report on KSADS-5 with youth report on the Prodromal Questionnaire Brief Version (PQ-B) (Loewy et al., 2005, 2012, 2011; Ising et al., 2012; Therman et al., 2014) (annually) modified for use in children in our age range by Dr. Rachel Loewy and colleagues. The PQ-B shows good internal reliability (Fonseca-Pedrero et al., 2016; Xu et al., 2016) and convergent validity with clinician-measured assessment of psychosis risk symptoms (Loewy et al., 2011; Kline et al., 2012). The inclusion of an assessment of subclinical manifestations of psychosis will aid in addressing questions about the degree to which early experience of psychosis predict use of substances, versus substances eliciting and/or worsening experiences of psychosis. As noted below, the youth will be asked to self-report on psychosis at each in-person assessment (i.e., yearly).

4.3.2.2.2. Impulsivity. There is an intimate relationship between personality, mental health and substance involvement that is highly multifaceted and complex (Littlefield and Sher, 2016). Those traits that are most related to substance involvement (and externalizing behavior more generally) throughout the life span are those that are sometimes termed "impulsivity." However, rather than referring to a single trait or even 'supertrait,' psychometric research has revealed the various impulsivity traits represent distinct constructs. These constructs vary dramatically with respect to the degree they reflect differing higher-order traits such as those indexed by Big Three or Big Five models of personality (e.g., Digman, 1990; Goldberg, 1992; Zuckerman et al., 1993; John and Srivastava, 1999). Importantly, Whiteside and Lynam (Whiteside and Lynam, 2001) were able to identify four unique

dimensions of impulsivity that could be interpreted as reflecting (lack of) premeditation (e.g., not thinking before acting), urgency (e.g., acting without thinking *when upset*, difficulty controlling emotions), sensation seeking, and (lack of) perseverance (e.g., giving up easily). On the basis of these analyses, Whiteside et al. (Whiteside et al., 2005) developed the four-factor scale of impulsivity entitled the UPPS (for urgency, perseverance, premeditation, and sensation seeking) Impulsive Behavior Scale. Based on evidence suggesting that the construct of urgency could be further broken down into two types (i.e., negative affect and positive affect) (Cyders and Smith 2008), the UPPS was revised to include both a measure of positive and of negative urgency, the 59 item UPPS-P (Cyders et al., 2007).

A youth version consisting of 40-items covering the UPPS-P dimensions was subsequently developed (Zapolski et al., 2010). However, given the participant burden at baseline, we did not feel we could include the entire 40-item version. Consequently, we reached out to one of the co-developers of the youth version of the UPPS-P, Greg Smith, who was conducting a longitudinal study of the UPPS-P beginning with children of the approximate ABCD baseline age (5th grade students). For optimal properties in this longitudinal ABCD study, Smith recommended that we maintain compatibility with the short form developed by Lynam (Lynam 2013) for adults to the extent possible. Smith then undertook a series of analyses on his cohort of over 1900 subjects studied over three years (Smith, unpublished communication, 2014). Specifically, he used Lynam's exact short scales for negative urgency, lack of perseverance, and sensation seeking. For lack of planning, the child version only had 2 of the 4 items he used. For positive urgency, the child form had 3 of the 4 items he used. For lack of planning and positive urgency, Smith examined the internal consistency and corrected item-total correlations for all 8 items on the Lynam (Lynam, 2013) scale at 3 different waves of data: wave 1 (spring, 5th grade, when the kids were 10–11), wave 5 (spring, 7th grade), and wave 7 (spring, 8th grade). In all cases, the Lynam (2013) short scales looked adequate (given the short-form format with 4 items/scale) with the exception for lack of perseverance at ages 10–11 ($\alpha = 0.46$; alpha increased to 0.68 by 7th grade). For lack of planning, Smith added two items with the highest corrected item-total correlations within that scale. For positive urgency, one item with the highest corrected item-total correlation was added to the scale. Using this approach, we developed a 20-item youth short version of the UPPS-P that maintained the response format of the original child version, and most of the children's items that overlapped with the adult short form. The strategy that we adopted allows us to have reasonable harmonization of data obtained by other groups using the full-length child version and help us transition to the adult short form as our children become adolescents. Preliminary analyses based on the first 1167 ABCD participants showed reasonable internal consistency for negative urgency (0.65), positive urgency (0.77), lack of perseverance (0.67), and lack of planning (0.73) but relatively poor internal consistency for sensation seeking (0.49). We anticipate asking the youth to repeat self-report on the UPPS every two years at the longer bi-annual in-person assessment.

4.3.2.2.3. Behavioral inhibition and behavioral activation. Closely related to the concept of impulsivity are psychobiological models of behavior that focus on two broad motivational systems, the behavioral activation system (BAS) and the behavioral inhibition system (BIS). As described by Gray (Gray 1982), the BIS is sensitive to signals of punishment, signals of nonreward, novel stimuli, and “innate fear stimuli” which results in behavioral inhibition (e.g., passive avoidance), increased arousal and increased attention. In contrast, the BAS is sensitive to a range of positive reinforcers and the absence of punishment and is associated with a range of positive emotions and approach behavior. Both of these systems, in tandem, guide ongoing, motivated behavior and are hypothesized to be associated with distinct neurocircuitry and neurotransmitter systems. Importantly, there are considerable individual differences in the strength of these systems. To quantify trait-like individual variation in the strength of these trait-like

strength of these systems, Carver and White (Carver and White 1994) developed a 24 item scale (including filler items) to assess three facets of behavioral activation: Drive (intensity of goal directed behavior; 4 items, $\alpha = 0.76$), Fun seeking (enjoyment for its own sake, spontaneity; 4 items, $\alpha = 0.66$), and Reward Responsiveness (excitement over reinforcing outcomes; 5 items, $\alpha = 0.73$) and Behavioral Inhibition (e.g., worry, fearfulness; 7 items, $\alpha = 0.74$). (Note that four items of the original scale were unscored filler items.) Since the initial publication of the scale, it has been translated in multiple languages and has been used in numerous studies. Of particular relevance to ABCD, BAS subscale scores have been associated with substance use and addiction, including Reward Responsiveness (Kambouropoulos and Staiger, 2001; Johnson et al., 2003; Pardo et al., 2007; Hamilton et al., 2012; Studer et al., 2016; Wright et al., 2016), Drive (Loxton and Dawe, 2001; Franken et al., 2006; Keough and O'Connor, 2014; Urošević et al., 2015; Studer et al., 2016), and Fun Seeking (Loxton and Dawe, 2001; Johnson et al., 2003; Franken et al., 2006; Hamilton et al., 2012; Keough and O'Connor, 2014; Studer et al., 2016; Wright et al., 2016).

Pagliaccio et al.'s (Pagliaccio et al., 2016) abridged version of the BIS/BAS scale for youth and adults shortens the BIS and BAS Reward Responsiveness subscales and eliminates the Fun seeking subscale. However, we chose to retain BAS Fun as it is a reliable predictor of substance involvement in older samples. Preliminary analyses on the first 1167 ABCD participants yield alphas for the resulting scales were BIS (.66), BAS-Drive (.78), BAS Reward responsiveness (.62), and BAS FUN (.64). We anticipate asking the youth to repeat self-report on the BIS-BAS every two years at the longer bi-annual in-person assessment.

4.3.2.2.4. Psychopathology and function. As described above, we will start to collect dimensional assessments of psychopathology and function from the youth using the *Youth Self-Report* (YSR) (Achenbach, 2009) starting when the participant is age 12.

4.4. Parent mental health and personality

4.4.1. Family history of psychopathology

Establishing participants' biological family history was deemed critical for two reasons. First, biological family history of substance use disorders is a robust risk factor for the development of substance use disorder (Cotton, 1979; Stallings et al., 2016). Biometric modeling of twin data demonstrates that most of this liability is genetic that is shared across the externalizing spectrum (including alcohol use disorder, substance use disorder, and antisocial personality disorder) but with each disorder having disorder unique genetic influence beyond the general genetic influence on externalizing (Krueger et al., 2002; Kendler et al., 2011; Hicks et al., 2013). Second, this family history of substance use disorders appears to relate to neurocognitive deficits prior to exposure to addictive drugs (Begleiter et al., 1984; Polich et al., 1994; Giancola and Targer, 1999; Iacono et al., 2002). In addition, some data indicate that family history represents a vulnerability factor for substance-related brain damage (Tapert and Brown, 2000). Thus, characterizing family history of ABCD participants not only provides information on which subjects are likely to go on to become substance involved but also helps to characterize individual differences in etiologically relevant neurocognitive functions and, potentially, vulnerability to further substance-induced brain damage given a specific level of drug exposure. While direct interview of all members of a pedigree is desirable, cost and logistics preclude this option in most assessments of family history. The “family history method,” where one or more informants provide information as to the presence/absence of symptoms of various disorders of multiple family members, is the most commonly employed approach to assessing family. Although this approach is known to have relatively low diagnostic sensitivity as compared to direct assessment of relatives, specificity generally appears to be reasonable (Andreasen et al., 1986; Rice et al., 1995).

In ABCD we employed a version of the Family History Assessment Module Screener (FHAM-S) (Rice et al., 1995) that was used in the

National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) study (<http://www.ncanda.org/index.php>). In the ABCD FHAM-S version, we have parents report on the presence/absence of symptoms associated with alcohol use disorder, substance use disorder, depression, mania, psychosis, and antisocial personality disorder in all 1st and 2nd degree “blood relatives” of the youth. (That is, biological relatives including full and half-siblings, parents, grandparents, and aunts and uncles.) Characterizing each participant’s pedigree in this way will allow us to characterize not only the family history of each participant with respect to each of the classes of disorder listed above but also to create alternative indices beyond simple global designations such as the presence or absence of a family history of a given disorder. This includes measures ranging from *continuous indices* of genetic risk such as family history density that considers the number of affected 1st and 2nd degree relatives in the pedigree (e.g. Stoltenberg et al., 1998) whether or not the family history is unileal or bilineal (i.e., matrilineal, patrilineal, or both) (e.g., Volicer et al., 1983) or unigenerational (parental generation only) or multigenerational (i.e., parent and grandparent on one side) (Finn et al., 1990). Because some members of a pedigree are still moving through their period of risk for the disorders being assessed at the time of baseline assessment and because informants may only become aware of a problem in a relative following the baseline assessment, reassessment of family history may be useful at a future measurement occasion.

4.4.2. Self-Report of psychopathology

We also ask the primary caretaker parent to complete the Adult Self Report (Achenbach, 2009) bi-annually. Thus, similar behavioral dimensions relevant to psychopathology will be captured in youth self-reports, parent reports of youth behavior, and parent self-reports, facilitating family-based study of psychopathology. If time permits at later assessments, we will ask parents to complete this self-report measure again. In addition, in a future assessment, we will ask the primary caretaker parent to complete the Adult Behavior Checklist (Achenbach, 2009) about the other parent.

4.5. Teacher reports

To provide converging evidence about the youth’s behavior, we ask families to give permission to allow us to ask their youth’s teacher to complete the Brief Problem Monitor – Teacher Form (Achenbach, 2009) at each assessment wave. We chose the Brief Problem Monitor instead of the longer Teacher Report Form to reduce burden on teachers (see Table 4).

5. Six-month phone assessments

The ABCD study is also conducting very brief assessments of the child over the phone approximately half-way between each in-person assessment (i.e., six-month phone assessment). In addition to assessments of substance use, we also use the Brief Problem Monitor (Achenbach, 2009) from the Achenbach system as a very brief measure of current dimensional psychopathology from the youth’s perspective. However, in order to have the assessment include evaluation of positive affect as well as problem behavior, we also administer the positive affective items from the NIH Toolbox Battery (Gershon et al., 2013; Salsman et al., 2013) to the youth.

6. One year follow-up in-person assessments

Both parents and children are asked to return for an in-person assessment every year of the study. A longer assessment battery, similar to the baseline battery, will be administered every two years. In the intervening years we are administering a shorter battery that last approximately 2–3 h in total. We reassess all aspects of the demographic questionnaire that could change across time.

For physical health, we assess updates to the medical history and head injury assessment since the child was last seen, as well as current medications, using modifications of the same measures completed at baseline. We also added a brief parent assessment of the youth’s nutritional status. We also again assess pubertal development and menstrual status from both parent and youth using the same instruments as at baseline. As noted above, we also ask both the parent and youth a number of additional questions about the youth’s gender identity. We also again ask parents about their child’s involvement in sports and activities with a modification of the same instrument used at baseline. The modification focuses on sports and activities in which their child has been involved since their last in-person assessments. We again have the parent and youth report on the youth’s use of visual media. Finally, we reacquire all anthropometric assessments in children to continue to plot their growth curves.

For mental health, we have the parents again complete a subset of the KSADS-5 modules (externalizing, eating disorders, and psychosis), the Child Behavior Checklist and the 10-item mania scale from the P-GBI. In addition, we are further assessing autism spectrum symptoms. The KSADS-5 includes assessment of autism spectrum symptoms. However, like psychosis, the assessment focuses on full-blown symptoms that likely miss the subtler autism spectrum indicators. Thus, we included the brief Social Responsiveness Scale (Reiersen et al., 2008) at the first annual assessment as a dimensional assessment of autism spectrum traits from the parent perspective. For the Youth, we have them complete the suicide questions from the KSADS-5 to ensure continuity in assessment of self-injury and suicidal thoughts and behaviors. We also have the child complete the same Brief Problem Monitor from the 6 month assessment (Achenbach, 2009) and the positive affect items from the NIH Toolbox. In addition, we added in a 7-item child report of mania called the 7-Up (Youngstrom et al., 2013), and a 10-item delinquency scale so that we have youth as well as parent reports on these types of behaviors. The delinquency scale is a shortened version of the scale developed for use in the Causes and Correlated of Delinquency Program (Hoeve et al., 2008; Theobald et al., 2014). Lastly, at the one year assessment, we also begin administering the Adverse Life Events Scale (Tiet et al., 2001; Grant et al., 2004) from the PhenX collection asking for both parent and youth reports about events that the youth has experienced.

7. Summary

This article reports on the rationale and selection of measures for assessing demographics, physical health and mental health in the ABCD study. This battery is intended to address a comprehensive array of constructs relevant to both healthy and unhealthy brain and behavioral development in youth. It includes assessment from the perspective of the parent and the perspective of the youth, as well as teacher reports. Our belief is that this battery provides a foundational baseline assessment of the youth’s current function, setting the stage to examine changes in their function over time, as well as assess a variety of factors that we believe may serve either as resilience markers that predict healthy development, or risk factors for later challenges associated with physical health, mental health, and substance use and abuse.

Grant support

U01DA041120-01 (DMB, KS); U01DA041148 (ASP, MDA, JJH); U01DA041028 (DBC); U01DA041089 (SFT); U01DA041134 (DYT); U01DA041174 (NAK); U01DA041089 (MPP); U01DA041022 (DP); U01DA041106 (BZ); U01DA041117 (LC); U24DA041147 (TJ, SFT); K05AA017242 (KS).

Conflict disclosures

DMB consults for Amgen, Pfizer and Upsher-Smith on work related

to psychosis. MPP receives royalties for an article about methamphetamine in UpToDate. No other authors report conflicts of interest.

Acknowledgements

We wish to thank a number of colleagues in the field who provide very useful suggestions about the development of the physical and mental health assessment battery for the Adolescent Brain and Cognitive Development Study, including Kristin Buss, Laurie Chassin, Mary Fristad, Joan Luby, Greg Smith, Jennifer Tackett, and Eric Youngstrom. In addition, we wish to thank Allison Auchter and Margie Hernandez Mejia for their invaluable help in setting up and implementing the battery.

References

- Achenbach, T.M., 2009. The Achenbach System of Empirically Based Assessment (ASEBA): Development, Findings, Theory and Applications. University of Vermont Research Center for Children, Youth, and Families, Burlington, VT.
- Albaugh, M.D., Nguyen, T.V., et al., 2017. Age-related volumetric change of limbic structures and subclinical anxious/depressed symptomatology in typically developing children and adolescents. *Biol. Psychol.* 124, 133–140.
- Ameis, S.H., Ducharme, S., et al., 2014. Cortical thickness, cortico-amygdalar networks, and externalizing behaviors in healthy children. *Biol. Psychiatry* 75 (1), 65–72.
- Andreasen, N.C., Rice, J., et al., 1986. The family history approach to diagnosis. How useful is it? *Arch. Gen. Psychiatry* 43 (5), 421–429.
- Baker, F.C., Willoughby, A.R., et al., 2016. Age-related differences in sleep architecture and electroencephalogram in adolescents in the national consortium on alcohol and neurodevelopment in adolescence sample. *Sleep* 39 (7), 1429–1439.
- Barch, D.M., Gotlib, I.H., et al., 2016. Common measures for national institute of mental health funded research. *Biol. Psychiatry* 79 (12), e91–96.
- Begleiter, H., Porjesz, B., et al., 1984. Event-related brain potentials in boys at risk for alcoholism. *Science* 225 (4669), 1493–1496.
- Bogner, J.A., Whiteneck, G.G., et al., 2017. Test-retest reliability of traumatic brain injury outcome measures: a traumatic brain injury model systems study. *J. Head Trauma Rehabil.*
- Bohnert, A.M., Garber, J., 2007. Prospective relations between organized activity participation and psychopathology during adolescence. *J. Abnorm. Child Psychol.* 35 (6), 1021–1033.
- Brooks-Gunn, J., Warren, M.P., et al., 1987. Validity of self-report measures of girls' pubertal status. *Child Dev.* 58 (3), 829–841.
- Brown, S.A., Brumback, T., et al., 2015. The national consortium on alcohol and NeuroDevelopment in adolescence (NCANDA): a multisite study of adolescent development and substance use. *J. Stud. Alcohol Drugs* 76 (6), 895–908.
- Bruni, O., Ottaviano, S., et al., 1996. The Sleep Disturbance Scale for Children (SDSC). Construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence. *J. Sleep Res.* 5 (4), 251–261.
- CDC (Division of Nutrition, P. A. a. O), 2016. *Anthropometry Procedures Manual*. CDC. https://www.cdc.gov/nchs/data/nhanes/2015-2016/manuals/2016_Anthropometry_Procedures_Manual.pdf.
- CDC, 2016. *Youth Risk Behavior Survey*. <https://www.cdc.gov/healthyouth/data/yrbys/>.
- Carver, C.S., White, T.L., 1994. Behavioral inhibition, behavioral activation and affective responses to impending reward and punishment: the BIS/BAS scales. *J. Pers. Soc. Psychol.* 67 (2), 319–333.
- Chambers, W.J., Puig-Antich, J., et al., 1985. The assessment of affective disorders in children and adolescents by semistructured interview. Test-retest reliability of the schedule for affective disorders and schizophrenia for school-age children, present episode version. *Arch. Gen. Psychiatry* 42 (7), 696–702.
- Conway, K.P., Vullo, G.C., et al., 2014. Data compatibility in the addiction sciences: an examination of measure commonality. *Drug Alcohol Depend.* 141, 153–158.
- Corrigan, J.D., Bogner, J., 2007. Initial reliability and validity of the ohio state university TBI identification method. *J. Head Trauma Rehabil.* 22 (6), 318–329.
- Corwin, D.J., Zonfrillo, M.R., et al., 2014. Characteristics of prolonged concussion recovery in a pediatric subspecialty referral population. *J. Pediatr.* 165 (6), 1207–1215.
- Cotton, N.S., 1979. The familial incidence of alcoholism: a review. *J. Stud. Alcohol* 40 (1), 89–116.
- Cyders, M.A., Smith, G.T., 2008. Emotion-based dispositions to rash action: positive and negative urgency. *Psychol. Bull.* 134 (6), 807–828.
- Cyders, M.A., Smith, G.T., et al., 2007. Integration of impulsivity and positive mood to predict risky behavior: development and validation of a measure of positive urgency. *Psychol. Assess.* 19 (1), 107–118.
- Dawson, W.J., 2014. Benefits of music training are widespread and lifelong: a bibliographic review of their non-musical effects. *Med. Probl. Perform. Art* 29 (2), 57–63.
- Depue, R.A., Krauss, S., et al., 1989. General behavior inventory identification of unipolar and bipolar affective conditions in a nonclinical university population. *J. Abnorm. Psychol.* 98 (2), 117–126.
- de Zambotti, M., Baker, F.C., et al., 2015. Validation of sleep-tracking technology compared with polysomnography in adolescents. *Sleep* 38 (9), 1461–1468.
- Diemer, M.A., Mistry, R.S., et al., 2012. Best practices in conceptualizing and measure social class in psychological research. *Anal. Soc. Issues Public Policy* 13 (1), 77–113.
- Digman, J.M., 1990. Personality structure: emergence of the five-factor model. *Annu. Rev. Psychol.* 41 (1), 417–440.
- Dolenc, P., 2015. Anxiety, self-esteem and coping with stress in secondary school students in relation to involvement in organized sports. *Zdr Varst* 54 (3), 222–229.
- Ducharme, S., Hudziak, J.J., et al., 2011. Right anterior cingulate cortical thickness and bilateral striatal volume correlate with child behavior checklist aggressive behavior scores in healthy children. *Biol. Psychiatry* 70 (3), 283–290.
- Ducharme, S., Hudziak, J.J., et al., 2012. Decreased regional cortical thickness and thinning rate are associated with inattention symptoms in healthy children. *J. Am. Acad. Child Adolesc. Psychiatry* 51 (1), 18–27 (e12).
- Ducharme, S., Albaugh, M.D., et al., 2015. Trajectories of cortical surface area and cortical volume maturation in normal brain development. *Data Brief* 5, 929–938.
- Ellis, M.J., Ritchie, L.J., et al., 2015. Psychiatric outcomes after pediatric sports-related concussion. *J. Neurosurg. Pediatr.* 16 (6), 709–718.
- Ferreira, V.R., Carvalho, L.B., et al., 2009. Sleep disturbance scale for children: translation, cultural adaptation, and validation. *Sleep Med.* 10 (4), 457–463.
- Finn, P.R., Kleinman, L., et al., 1990. The lifetime prevalence of psychopathology in men with multigenerational family histories of alcoholism. *J. Nerv. Ment. Dis.* 178 (8), 500–504.
- Fisher, S.L., Bucholz, K.K., et al., 2006. Teenagers are right? parents do not know much: an analysis of adolescent-parent agreement on reports of adolescent substance use, abuse, and dependence. *Alcohol. Clin. Exp. Res.* 30 (10), 1699–1710.
- Foley, D., Rutter, M., et al., 2004. Informant disagreement for separation anxiety disorder. *J. Am. Acad. Child Adolesc. Psychiatry* 43 (4), 452–460.
- Fonseca-Pedrero, E., Gooding, D.C., et al., 2016. Assessing self-reported clinical high risk symptoms in community-derived adolescents: a psychometric evaluation of the prodromal questionnaire-brief. *Compr. Psychiatry* 66, 201–208.
- Franken, I.H., Muris, P., et al., 2006. Gray's model of personality and addiction. *Addict. Behav.* 31 (3), 399–403.
- Gershon, R.C., Wagster, M.V., et al., 2013. NIH toolbox for assessment of neurological and behavioral function. *Neurology* 80 (11 Suppl. 3), S2–6.
- Giancola, P.R., Targer, R.E., 1999. Executive cognitive functioning and risk for substance abuse. *Psychol. Sci.* 10 (3), 203–205.
- Godfrey, C., Devine-Wright, H., et al., 2015. The positive impact of structured surfing courses on the wellbeing of vulnerable young people. *Community Pract.* 88 (1), 26–29.
- Goldberg, L.R., 1992. The development of markers for the Big-Five factor structure. *Psychol. Assess.* 4 (1), 26.
- Grant, K.E., Compas, B.E., et al., 2004. Stressors and child and adolescent psychopathology: measurement issues and prospective effects. *J. Clin. Child Adolesc. Psychol.* 33 (2), 412–425.
- Gray, J.A., 1982. *The Neuropsychology of Anxiety: An Inquiry into the Functions of the Septo-Hippocampal Systems*. Oxford University Press, Oxford, England.
- Grills, A.E., Ollendick, T.H., 2002. Issues in parent-child agreement: the case of structured diagnostic interviews. *Clin. Child Fam. Psychol. Rev.* 5 (1), 57–83.
- Hamilton, C.M., Strader, L.C., et al., 2011. The PhenX Toolkit: get the most from your measures. *Am. J. Epidemiol.* 174 (3), 253–260.
- Hamilton, K.R., Sinha, R., et al., 2012. Hazardous drinking and dimensions of impulsivity, behavioral approach, and inhibition in adult men and women. *Alcohol. Clin. Exp. Res.* 36 (6), 958–966.
- Hasler, B.P., Clark, D.B., 2013. Circadian misalignment, reward-related brain function, and adolescent alcohol involvement. *Alcohol. Clin. Exp. Res.* 37 (4), 558–565.
- Hasler, B.P., Martin, C.S., et al., 2014. A longitudinal study of insomnia and other sleep complaints in adolescents with and without alcohol use disorders. *Alcohol. Clin. Exp. Res.* 38 (8), 2225–2233.
- Hasler, B.P., Kirisci, L., et al., 2016. Restless sleep and variable sleep timing during late childhood accelerate the onset of alcohol and other drug involvement. *J. Stud. Alcohol Drugs* 77 (4), 649–655.
- Hicks, B.M., Foster, K.T., et al., 2013. Genetic and environmental influences on the familial transmission of externalizing disorders in adoptive and twin offspring. *JAMA Psychiatry* 70 (10), 1076–1083.
- Hillman, C.H., Erickson, K.I., et al., 2008. Be smart, exercise your heart: exercise effects on brain and cognition. *Nat. Rev. Neurosci.* 9 (1), 58–65.
- Hoeve, M., Blokland, A., et al., 2008. Trajectories of delinquency and parenting styles. *J. Abnorm. Child Psychol.* 36 (2), 223–235.
- Hull, J.G., Brunelle, T.J., et al., 2014. A longitudinal study of risk-glorifying video games and behavioral deviance. *J. Pers. Soc. Psychol.* 107 (2), 300–325.
- Huppertz, C., Bartels, M., et al., 2016. Individual differences in exercise behavior: stability and change in genetic and environmental determinants from age 7–18. *Behav. Genet.* 46 (5), 665–679.
- Iacono, W.G., Carlson, S.R., et al., 2002. P3 event-related potential amplitude and the risk for disinhibitory disorders in adolescent boys. *Arch. Gen. Psychiatry* 59 (8), 750–757.
- Ising, H.K., Veling, W., et al., 2012. The validity of the 16-item version of the Prodromal Questionnaire (PQ-16) to screen for ultra high risk of developing psychosis in the general help-seeking population. *Schizophr. Bull.* 38 (6), 1288–1296.
- Jewett, R., Sabiston, C.M., et al., 2014. School sport participation during adolescence and mental health in early adulthood. *J. Adolesc. Health* 55 (5), 640–644.
- Ji, X., Liu, J., 2016. Subjective sleep measures for adolescents: a systematic review. *Child Care Health Dev.* 42 (6), 825–839.
- John, O.P., Srivastava, S., 1999. The Big Five trait taxonomy: history, measurement, and theoretical perspectives. *Handb. Pers.: Theory Res.* 2, 102–138.
- Johnson, S.L., Turner, R.J., et al., 2003. BIS/BAS levels and psychiatric disorder: an epidemiological study. *J. Psychopathol. Behav. Assess.* 25, 25–36.
- Kagan, J., Moss, H.A., 1962. *Birth to Maturity: A Study in Psychological Development*. Wiley Press, New York.
- Kaltiala-Heino, R., Marttunen, M., et al., 2003. Early puberty is associated with mental

- health problems in middle adolescence. *Soc. Sci. Med.* 57 (6), 1055–1064.
- Kambouropoulos, N., Staiger, P.K., 2001. The influence of sensitivity to reward on reactivity to alcohol-related cues. *Addiction* 96 (8), 1175–1185.
- Kaufman, J., Birmaher, B., et al., 1997. Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. *J. Am. Acad. Child Adolesc. Psychiatry* 36 (7), 980–988.
- Kaufman, J., Birmaher, B., et al., 2000. K-SADS-PL. *J. Am. Acad. Child Adolesc. Psychiatry* 39 (10), 1208.
- Kaufman, J., Birmaher, B., et al., 2013. KSADS-PL. Yale University, New Haven, CT.
- Kendler, K.S., Gardner, C., et al., 2011. Predicting alcohol consumption in adolescence from alcohol-specific and general externalizing genetic risk factors, key environmental exposures and their interaction. *Psychol. Med.* 41 (7), 1507–1516.
- Keough, M.T., O'Connor, R.M., 2014. Clarifying the measurement and the role of the behavioral inhibition system in alcohol misuse. *Alcohol. Clin. Exp. Res.* 38 (5), 1470–1479.
- Kessler, R.C., Avenevoli, S., et al., 2009a. Design and field procedures in the US national comorbidity survey replication adolescent supplement (NCS-A). *Int. J. Methods Psychiatr. Res.* 18 (2), 69–83.
- Kessler, R.C., Avenevoli, S., et al., 2009b. National comorbidity survey replication adolescent supplement (NCS-A): II. Overview and design. *J. Am. Acad. Child Adolesc. Psychiatry* 48 (4), 380–385.
- Kirkcaldy, B.D., Shephard, R.J., et al., 2002. The relationship between physical activity and self-image and problem behaviour among adolescents. *Soc. Psychiatry Psychiatr. Epidemiol.* 37 (11), 544–550.
- Kline, E., Wilson, C., et al., 2012. Psychosis risk screening in youth: a validation study of three self-report measures of attenuated psychosis symptoms. *Schizophr. Res.* 141 (1), 72–77.
- Kobak, K.A., Kaufman, J., 2015. Ksads-comp. Center for Telepsychology, Madison, WI.
- Kobak, K.A., Kratochvil, C.J., et al., 2013. Computerized screening of comorbidity in adolescents with substance or psychiatric disorders. *Anxiety Disorders and Depression*. (La Jolla, CA).
- Kraan, T., Velthorst, E., et al., 2016. Cannabis use and transition to psychosis in individuals at ultra-high risk: review and meta-analysis. *Psychol. Med.* 46 (4), 673–681.
- Kremer, P., Elshaug, C., et al., 2014. Physical activity, leisure-time screen use and depression among children and young adolescents. *J. Sci. Med. Sport* 17 (2), 183–187.
- Krueger, R.F., Hicks, B.M., et al., 2002. Etiologic connections among substance dependence, antisocial behavior, and personality: modeling the externalizing spectrum. *J. Abnorm. Psychol.* 111 (3), 411–424.
- Ksir, C., Hart, C.L., 2016. Cannabis and psychosis: a critical overview of the relationship. *Curr. Psychiatry Rep.* 18 (2), 12.
- Levin, F.R., Hennessy, G., 2004. Bipolar disorder and substance abuse. *Biol. Psychiatry* 56 (10), 738–748.
- Levine, A., Clemenza, K., et al., 2017. Evidence for the risks and consequences of adolescent cannabis exposure. *J. Am. Acad. Child Adolesc. Psychiatry* 56 (3), 214–225.
- Littlefield, A.K., Sher, K.J., 2016. Personality and substance use disorders. In: Sher, K.J. (Ed.), *The Oxford Handbook of Substance Use and Substance Use Disorders*. Oxford University Press, Oxford, pp. 351–374.
- Loewy, R.L., Bearden, C.E., et al., 2005. The prodromal questionnaire (PQ): preliminary validation of a self-report screening measure for prodromal and psychotic syndromes. *Schizophr. Res.* 79 (1), 117–125.
- Loewy, R.L., Pearson, R., et al., 2011. Psychosis risk screening with the Prodromal Questionnaire—brief version (PQ-B). *Schizophr. Res.* 129 (1), 42–46.
- Loewy, R.L., Therman, S., et al., 2012. Prodromal psychosis screening in adolescent psychiatry clinics. *Early Interv. Psychiatry* 6 (1), 69–75.
- Loxton, N.J., Dawe, S., 2001. Alcohol abuse and dysfunctional eating in adolescent girls: the influence of individual differences in sensitivity to reward and punishment. *Int. J. Eat. Disord.* 29 (4), 455–462.
- Lynam, D.R., 2013. Development of the Short Form of the UPPS-P Impulsive Behavior Scale. Unpublished Technical Report.
- Maiese, D.R., Hendershot, T., et al., 2013. PhenX: Establishing a Consensus Process to Select Common Measures for Collaborative Research. RTI Press Publication NO MR-0027-1310. RTI Press, Research Triangle Park, NC.
- Marconi, A., Di Forti, M., et al., 2016. Meta-analysis of the association between the level of cannabis use and risk of psychosis. *Schizophr. Bull.* 42 (5), 1262–1269.
- McCarty, C.A., Huggins, W., et al., 2014. PhenX RISING: real world implementation and sharing of PhenX measures. *BMC Med. Genomics* 7, 16.
- McClure, A.C., Tanski, S.E., et al., 2010. Characteristics associated with low self-esteem among US adolescents. *Acad. Pediatr.* 10 (4), 238–244 (e232).
- McLoyd, V.C., 1998. Socioeconomic disadvantage and child development. *Am. Psychol.* 53 (2), 185–204.
- Mednick, S.A., McNeil, T.F., 1968. Current methodology in research on the etiology of schizophrenia: serious difficulties which suggest the use of the high-risk-group method. *Psychol. Bull.* 70 (6), 681–693.
- Mejia, R., Perez, A., et al., 2016. Parental restriction of mature-rated media and its association with substance use among argentinean adolescents. *Acad. Pediatr.* 16 (3), 282–289.
- Merikangas, K., Avenevoli, S., et al., 2009. National comorbidity survey replication adolescent supplement (NCS-A): I. Background and measures. *J. Am. Acad. Child Adolesc. Psychiatry* 48 (4), 367–369.
- Miller, C.L., Tucker, M.L., et al., 1988. Measuring Pubertal Development: A Comparison of Different Scales and Different Sources. University of Michigan.
- NHLBI, 2000. Multi-Ethnic Study of Artherosclerosis (MESA). Medications.
- Nuyens, F., Deleuze, J., et al., 2016. Impulsivity in multiplayer online battle arena gamers: preliminary results on experimental and self-report measures. *J. Behav. Addict.* 5 (2), 351–356.
- Orvaschel, H., Puig-Antich, J., et al., 1982. Retrospective assessment of prepubertal major depression with the Kiddie-SADS-e. *J. Am. Acad. Child Psychiatry* 21 (4), 392–397.
- Pagliaccio, D., Luking, K.R., et al., 2016. Revising the BIS/BAS Scale to study development: measurement invariance and normative effects of age and sex from childhood through adulthood. *Psychol. Assess.* 28 (4), 429–442.
- Pardo, Y., Aguilar, R., et al., 2007. Alcohol use as a behavioural sign of disinhibition: evidence from J.A. Gray's model of personality. *Addict. Behav.* 32 (10), 2398–2403.
- Petersen, A.C., Crockett, L., et al., 1988. A self-report measure of pubertal status: reliability, validity, and initial norms. *J. Youth Adolesc.* 17 (2), 117–133.
- Polich, J., Pollock, V.E., et al., 1994. Meta-analysis of P300 amplitude from males at risk for alcoholism. *Psychol. Bull.* 115 (1), 55–73.
- Reiersen, A.M., Constantino, J.N., et al., 2008. Evidence for shared genetic influences on self-reported ADHD and autistic symptoms in young adult Australian twins. *Twin Res. Hum. Genet.* 11 (6), 579–585.
- Rey, J.M., Schrader, E., et al., 1992. Parent-child agreement on children's behaviours reported by the Child Behaviour Checklist (CBCL). *J. Adolesc.* 15 (3), 219–230.
- Rice, J.P., Reich, T., et al., 1995. Comparison of direct interview and family history diagnoses of alcohol dependence. *Alcohol. Clin. Exp. Res.* 19 (4), 1018–1023.
- Rockhill, C.M., Russo, J.E., et al., 2007. Agreement between parents and children regarding anxiety and depression diagnoses in children with asthma. *J. Nerv. Ment. Dis.* 195 (11), 897–904.
- Rothen, S., Vandelour, C.L., et al., 2009. Parent-child agreement and prevalence estimates of diagnoses in childhood: direct interview versus family history method. *Int. J. Methods Psychiatr. Res.* 18 (2), 96–109.
- Rutter, M., Kim-Cohen, J., et al., 2006. Continuities and discontinuities in psychopathology between childhood and adult life. *J. Child Psychol. Psychiatry Allied Discip.* 47 (3–4), 276–295.
- Salsman, J.M., Butt, Z., et al., 2013. Emotion assessment using the NIH toolbox. *Neurology* 80 (11 Suppl. 3), S76–86.
- Schou Andreassen, C., Billieux, J., et al., 2016. The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: a large-scale cross-sectional study. *Psychol. Addict. Behav.* 30 (2), 252–262.
- Segev, A., Mimouni-Bloch, A., et al., 2015. Evaluating computer screen time and its possible link to psychopathology in the context of age: a cross-sectional study of parents and children. *PLoS One* 10 (11), e0140542.
- Sharif, I., Wills, T.A., et al., 2010. Effect of visual media use on school performance: a prospective study. *J. Adolesc. Health* 46 (1), 52–61.
- Sherwood Brown, E., Suppes, T., et al., 2001. Drug abuse and bipolar disorder: comorbidity or misdiagnosis? *J. Affect. Disord.* 65 (2), 105–115.
- Smith, T.W., Marsden, P., et al., 2015. General Social Surveys, 1972–2012: Cumulative Codebook. NORC at the University of Chicago, Chicago.
- Snyder, A.R., Martinez, J.C., et al., 2010. Health-related quality of life differs between adolescent athletes and adolescent nonathletes. *J. Sport Rehabil.* 19 (3), 237–248.
- Sourander, A., Aromaa, M., et al., 2006a. Early predictors of deliberate self-harm among adolescents: a prospective follow-up study from age 3 to age 15. *J. Affect. Disord.* 93 (1–3), 87–96.
- Sourander, A., Pihlakoski, L., et al., 2006b. Early predictors of parent- and self-reported perceived global psychological difficulties among adolescents: a prospective cohort study from age 3 to age 15. *Soc. Psychiatry Psychiatr. Epidemiol.* 41 (3), 173–182.
- Spruyt, K., Gozal, D., 2011. Pediatric sleep questionnaires as diagnostic or epidemiological tools: a review of currently available instruments. *Sleep Med. Rev.* 15 (1), 19–32.
- Stallings, M.C., Gizer, I.R., et al., 2016. Genetic epidemiology and molecular genetics. In: Sher, K.J. (Ed.), *The Oxford Handbook of Substance Use and Substance Use Disorders*, vol. 1. Oxford University Press, Oxford, pp. 192–272.
- Stoltenberg, S.F., Mudd, S.A., et al., 1998. Evaluating measures of family history of alcoholism: density versus dichotomy. *Addiction* 93 (10), 1511–1520.
- Stover, P.J., Harlan, W.R., et al., 2010. PhenX: a toolkit for interdisciplinary genetics research. *Curr. Opin. Lipidol.* 21 (2), 136–140.
- Strakowski, S.M., DelBello, M.P., 2000. The co-occurrence of bipolar and substance use disorders. *Clin. Psychol. Rev.* 20 (2), 191–206.
- Strakowski, S.M., DelBello, M.P., et al., 2000. The impact of substance abuse on the course of bipolar disorder. *Biol. Psychiatry* 48 (6), 477–485.
- Studer, J., Baggio, S., et al., 2016. Drinking motives As mediators of the associations between reinforcement sensitivity and alcohol misuse and problems. *Front. Psychol.* 7, 718.
- Taliaferro, L.A., Eisenberg, M.E., et al., 2011. Sport participation during adolescence and suicide ideation and attempts. *Int. J. Adolesc. Med. Health* 23 (1), 3–10.
- Tapert, S.F., Brown, S.A., 2000. Substance dependence, family history of alcohol dependence and neuropsychological functioning in adolescence. *Addiction* 95 (7), 1043–1053.
- Theobald, D., Farrington, D.P., et al., 2014. Scaling up from convictions to self-reported offending. *Crim. Behav. Ment. Health* 24 (4), 265–276.
- Therman, S., Lindgren, M., et al., 2014. Predicting psychosis and psychiatric hospital care among adolescent psychiatric patients with the Prodromal Questionnaire. *Schizophr. Res.* 158 (1–3), 7–10.
- Tiemeier, H., Velders, F.P., et al., 2012. The Generation R Study: a review of design, findings to date, and a study of the 5-HTTLPR by environmental interaction from fetal life onward. *J. Am. Acad. Child Adolesc. Psychiatry* 51 (11), 1119–1135 (e1117).
- Tiet, Q.Q., Bird, H.R., et al., 2001. Relationship between specific adverse life events and psychiatric disorders. *J. Abnorm. Child Psychol.* 29 (2), 153–164.
- Todd, R.D., Joyner, C.A., et al., 2003. Reliability and stability of a semistructured DSM-IV interview designed for family studies. *J. Am. Acad. Child Adolesc. Psychiatry* 42 (12), 1460–1468.
- Urosevic, S., Collins, P., et al., 2015. Effects of reward sensitivity and regional brain volumes on substance use initiation in adolescence. *Soc. Cogn. Affect. Neurosci.* 10 (1), 106–113.

- van Rooij, A.J., Kuss, D.J., et al., 2014. The (co-)occurrence of problematic video gaming, substance use, and psychosocial problems in adolescents. *J Behav Addict* 3 (3), 157–165.
- Vella, S.A., Swann, C., et al., 2016. Bidirectional associations between sport involvement and mental health in adolescence. *Med. Sci. Sports Exerc.*
- Verhulst, F.C., van der Ende, J., 1992. Agreement between parents' reports and adolescents' self-reports of problem behavior. *J. Child Psychol. Psychiatry* 33 (6), 1011–1023.
- Virji-Babul, N., Hilderman, C.G., et al., 2014. Changes in functional brain networks following sports-related concussion in adolescents. *J. Neurotrauma* 31 (23), 1914–1919.
- Volicer, B.J., Volicer, L., et al., 1983. Variation in length of time to development of alcoholism by family history of problem drinking. *Drug Alcohol Depend.* 12 (1), 69–83.
- Whiteside, S.P., Lynam, D.R., 2001. The five factor model and impulsivity: using a structural model of personality to understand impulsivity. *Pers. Individ. Differ.* 30, 669–689.
- Whiteside, S.P., Lynam, D.R., et al., 2005. Validation of the UPPS impulsive behaviour scale: a four-factor model of impulsivity. *Eur. J. Pers.* 19 (7), 559–574.
- Wilens, T.E., Biederman, J., et al., 1999. Risk for substance use disorders in youths with child- and adolescent-onset bipolar disorder. *J. Am. Acad. Child Adolesc. Psychiatry* 38 (6), 680–685.
- Wilens, T.E., Biederman, J., et al., 2008. Further evidence of an association between adolescent bipolar disorder with smoking and substance use disorders: a controlled study. *Drug Alcohol Depend.* 95 (3), 188–198.
- Wright, N.E., Scerpella, D., et al., 2016. Marijuana use is associated with behavioral approach and depressive symptoms in adolescents and emerging adults. *PLoS One* 11 (11), e0166005.
- Xu, L., Zhang, T., et al., 2016. Psychometric properties of prodromal questionnaire-brief version among chinese help-seeking individuals. *PLoS One* 11 (2), e0148935.
- Youngstrom, E.A., Findling, R.L., et al., 2001. Discriminative validity of parent report of hypomanic and depressive symptoms on the General Behavior Inventory. *Psychol. Assess.* 13 (2), 267–276.
- Youngstrom, E.A., Frazier, T.W., et al., 2008. Developing a 10-item mania scale from the Parent General Behavior Inventory for children and adolescents. *J. Clin. Psychiatry* 69 (5), 831–839.
- Youngstrom, E.A., Murray, G., et al., 2013. The 7 up 7 down inventory: a 14-item measure of manic and depressive tendencies carved from the general behavior inventory. *Psychol. Assess.* 25, 1377–1383.
- Zapolski, T.C., Stairs, A.M., et al., 2010. The measurement of dispositions to rash action in children. *Assessment* 17 (1), 116–125.
- Zuckerman, M., Huhlman, D.M., et al., 1993. A comparison of three structural models for personality: the Big Three, the Big Five, and the Alternative Five. *J. Pers. Soc. Psychol.* 65 (4), 757–768.