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Authors

Roy, Arunima
Hechtman, Lily
Arnold, L Eugene
et al.

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Childhood predictors of adult functional outcomes in the Multimodal Treatment study of ADHD (MTA)

Dr. Arunima Roy, MBBS, Ph.D.,
Division of Molecular Psychiatry, University Hospital Würzburg

Dr. Lily Hechtman, M.D.,
Division of Child Psychiatry, McGill University

Dr. L. Eugene Arnold, M.D.,
Department of Psychiatry, Ohio State University

Dr. James M. Swanson, Ph.D.,
Child Development Center, University of California, Irvine

Dr. Brooke S. G. Molina, Ph.D.,
Departments of Psychiatry and Psychology, University of Pittsburgh School of Medicine

Dr. Margaret H. Sibley, Ph.D., and
Department of Psychiatry, Florida International University

Dr. Andrea L. Howard, Ph.D.
Department of Psychology, Carleton University

for the MTA Cooperative Group

Abstract

Background—Recent results from the Multimodal Treatment Study of ADHD (MTA) demonstrated impairments in several functioning domains in adults with childhood ADHD. The childhood predictors of these adult functional outcomes are not adequately understood.

Objective—To determine effects of childhood demographic, clinical and family factors on adult functional outcomes in individuals with and without childhood ADHD from the MTA cohort.

Methods—Regressions were used to determine associations of childhood factors (age range = 7–10 years) of family income, IQ, comorbidity (internalizing, externalizing and total number of non-ADHD diagnoses), parenting styles, parental education, number of household members, parental

marital problems, parent-child relationships, and ADHD symptom severity with adult outcomes (mean age = 25) of occupational functioning, educational attainment, emotional functioning, sexual behavior, and justice involvement in participants with (n = 579) and without (n = 258) ADHD.

Results—Predictors of adult functional outcomes in ADHD include clinical factors such as baseline ADHD severity, IQ and comorbidity, demographic factors such as family income, number of household members and parental education, as well as family factors such as parental monitoring and parental marital problems. Predictors of adult outcomes were generally comparable for children with and without ADHD.

Conclusion—Childhood ADHD symptoms, IQ and household income levels are important predictors of adult functional outcomes. Management of these areas early on, through timely treatments for ADHD symptoms, and providing additional support to children with lower IQ and from households with low incomes, may assist in improving adult functioning.

INTRODUCTION

Problems with occupational performance, emotional adjustments, legal involvement, and educational attainment, are common in adults with Attention Deficit/Hyperactivity Disorder (ADHD).[1–2] Although severity of ADHD influences functioning to some extent, adult functioning difficulties may be seen irrespective of concurrent ADHD symptoms.[1] This study aims to assess effects of childhood demographic, clinical and family factors on adult functional outcomes in participants from the Multimodal Treatment of children with ADHD (MTA).

This paper is based on two recent studies from the MTA.[3–4] First, Hechtman et al.[3] demonstrated poor function al outcomes in adults with persistent and desistant ADHD symptoms. Importantly, three patterns of functioning were noted: For educational, occupational, and risk-taking behaviors, ADHD symptom persisters showed the worst profile followed by symptom desisters, with the controls showing the best functional outcomes. In a second pattern, emotional lability outcomes were poor only in ADHD symptom persisters, while desisters performed comparably to controls. In a third pattern, both symptom persisters and desisters fared equally well compared to the controls. In short, ADHD symptom persistence was demonstrated to be an important factor associated with some functional outcomes. However, comparable outcomes between persisters and desisters in other domains raise the question as to which factors beyond ADHD symptom persistence may predict eventual outcomes. We speculate that childhood factors may modify mental health trajectories and thereby influence eventual outcomes.

In the second study from our group, [4] Roy et al. examined effects of childhood demographic, clinical and family functioning factors on the risk for adult ADHD persistence. We showed that baseline ADHD symptom severity and parental mental health influenced adult ADHD

persistence. In the present study, we will focus on these three groups of childhood factors and examine their effects on adult functioning. The childhood factors under study are: demographic – including household income, number of individuals in the household, and parental education; clinical – including childhood IQ, comorbidity, and ADHD symptom severity; and family-related – including parental mar ital status, parent-child relationships, and parenting styles.

We also aim to assess if effects of demographic, clinical, and family factors differ for individuals with and without childhood ADHD: ADHD is associated with neurocognitive maturation delays and an added environmental risk may worsen developmental trajectories. In contrast, individuals with no ADHD may have greater resilience to environmental risks. Given this, it is important to assess the extent to which early factors affect outcomes in ADHD and how such effects may differ between children with and without ADHD.

METHODS

Sample

This study is based on the National Institute of Mental Health – MTA cohort, a 14-month randomized treatment study of 579 children with ADHD (ages 7–10 years), with naturalistic follow-ups for up to 16 years after baseline. The MTA also included an age- and sex-matched comparison group of 258 children without ADHD – the Local Normative Comparison Group (LNCG) – recruited 2 years after baseline, and who were thereafter followed up at similar intervals as the children with ADHD.

Follow-up assessments in the ADHD group and the LNCG were carried out in childhood (3 years after baseline), adolescence (6, 8 and 10 years after baseline), and adulthood (12, 14 and 16 years after baseline). For the current study, information on childhood demographic, clinical and family functioning was included from data available at the earliest time point. For the ADHD group (n = 579) this was at a mean age of 8.5 years (SD = 0.8), while for the LNCG (n = 289) – recruited 2 years after the ADHD group – this was at a mean age of 10.4 years (SD = 1.08). Information on functioning outcomes was included from the adulthood assessments and data from the last available time point of either 12, 14 or 16 years was used.

Further details on the MTA cohort are available in previous publications.[5–9] All study procedures were approved by Institutional Review Boards and were carried out in accordance with the Declaration of Helsinki. Participants were informed of the procedures and provided written informed consent.

Measures

1] Baseline Predictors

    i. Demographic factors: *Total household income* was measured on categorical scale of 1–10 (1 $10,000 per annum and 10 $75,000 per annum). *Parental education* was operationalized as the highest education received by either mother or father (the higher of the two) on a scale of 1 to 6 [1 = eighth grade or less; 2 = some high school; 3 = high school graduate or GED; 4 = some college or post-

high school; 5 = college graduate; 6 = advanced graduate or professional degree].
Total number of household members as reported by parents at baseline.

ii.   Clinical factors: _IQ_ was measured using the Wechsler Intelligence Scale for
       Children, 3rd ed. (WISC-III). The predictor variable used was full scale IQ,
       which is a composite measure of performance on all verbal and non-verbal
       subtests.[5] _Childhood comorbidity_ was defined as the total number of mental
       health disorder diagnoses (excluding ADHD) present according to DSM-III-R
       criteria as assessed by the Diagnostic Interview Schedule for Children – Parent
       version or DISC-P[10] (for the LNCG, total number of psychiatric disorders, and
       not comorbidity, was assessed with the DISC-P and according to the DSM-III-R
       criteria. In order to maintain consistency the term 'comorbidity' will be used for
       both the ADHD group and LNCG throughout the manuscript). DISC-P
       diagnoses were also classified into internalizing and externalizing problems for
       additional analyses (see 'sensitivity analyses' subsection in results). _ADHD_
       symptom severity at baseline was defined as mean parent- and teacher-reported
       scores on the Swanson, Nolan, and Pelham (SNAP) scale.[11]

iii.   Family factors: _Parenting styles_ were assessed using the child-reported Alabama
       Parenting Questionnaire (APQ). A total of 51 items are rated on a on a five-point
       scale (1 = never, 2 = almost never, 3 = sometimes, 4 = often, 5 = always) and
       composite scores on these items were used to define six domains of parenting
       practices: parental involvement, positive parenting, inconsistent discipline, low
       monitoring and supervision, appropriate discipline, harsh discipline. A low score
       indicated poor performance in that domain.[9] _Parent-child relationships_ were
       assessed using the parent-child relationship questionnaire.[9] Participants rated
       their agreement on 40 items on a five-point scale (1 = hardly, 2 = not too much, 3
       = somewhat, 4 = very much, 5 = extremely). Composite scores on these items
       were created to reflect five domains of parent-child relationships: possessive/
       protective, affectionate/admiring, conflicting, nurturing/intimate, participating/
       involved. As children's reports are a more accurate representation of family
       functioning, we relied only on participant (child's) reports for parenting styles
       and parent-child relationships.[12] _Parental marital problems_ were operationalized
       as the total number of separations/divorces (of mother/father figure) the child had
       experienced.

2] Adult outcomes—For all adult outcome measures, the oldest assessment time point
was used (either 12, 14, or 16 years) at which data was available.

i.   Occupational functioning was assessed using self-reports and operationalized as
       a) _public assistance_ (received: yes/no); b) _job changes_ (total number of times
       fired or quit), and; c) _income levels_ (measured on a scale of 1–10). [1 = no
       income; 2 $10,000 per annum and 10 $ 80,001 per annum).

ii.   Emotional functioning was operationalized as: a) _emotional lability_ measured
       using the emotional lability subscale of the Conner's Adult ADHD Rating
       Scale.[13] Scores were calculated by combining parent-/observer-and self-reports;

b) presence of any DSM *anxiety or mood disorders* assessed with DISC youth (DISC-YA) reports[10]; c) *neuroticism* operationalized as scores from participant reports on the NEO-Five-Factor Inventory[14]

iii. Educational attainment was assessed with participants' reports of highest educational degree (received or in the process of being received), and operationalized as having received a *bachelor's degree* or not (yes/no).

iv. Sexual behavior was operationalized as self-reported a) *age at first sexual contact*, and; b) *total number of sexual partners* (in lifetime).

v. Justice involvement was operationalized as the total self-reported incidents of *contact with police*

III] Control variables: age at follow-up, sex and MTA site were included as control variables—Further details on the baseline and outcome variables are available in previous publications of the MTA.[3–9,15]

Analyses

Data were missing for several predictor (1–5% missingness) and outcome variables (1 – 32% missingness). We performed multiple imputations by chained equations using fully conditional specification to avoid loss of statistical power. To check the assumption that data were missing at random (MAR), we assessed if variables with complete information predicted missingness. Results from logistic regressions showed that non-missing variables in our data predicted up to 38% of the variance (Nagelkerke R^2) in missingness, partly supporting the assumption of MAR. Next, we created models for data imputation wherein all variables that were correlated (bivariate correlations 0.1) with missingness in the data were included. Separate models were used to specify the distribution for each variable with missing data.[16] Predictive mean matching was used to impute missing data for continuous variables, while ordered logit models and multinomial logit models were used to impute ordinal and categorical variables, respectively. A total of one hundred imputed datasets were constructed and convergence was assessed visually using trace line plots of the mean and variance of imputed values against iteration number. Results from each imputed dataset were pooled according to Rubin's method for multiple imputation inference.[17]

Regressions were used to determine associations between baseline predictors and adulthood outcomes: linear regressions were used for outcomes of emotional lability, age at first sexual contact, and neuroticism. Logistic regressions were used for outcomes of public assistance, justice involvement, educational attainment, mood and anxiety disorders. Poisson regressions were used for outcomes of job changes and total number of sexual partners. Ordered logit regression was used for the outcome income levels. Baseline household income and parental education were entered as continuous predictors in the models.

We based our analyses on the strategy used by Kaplow, Curran, and Dodge.[18] In a first step, each predictor domain (encompassing a set of baseline factors) was entered in the regression model separately to determine associations with each adult outcome. For the demographic domain, included predictors were childhood household income, parental education, and total

number of household members. The family functioning domain included baseline predictors parent-child relationships, parenting styles and parental marital problems. The clinical domain included childhood comorbidity, ADHD symptom severity, and IQ. Supplementary table S1 presents regression results for predictor selection. In the second step, composite regression models were created including predictors from step 1 with a p < .05, and controlling forage at follow-up, sex, and MTA site. In the third step, we added interactions of group type (ADHD or LNCG) with predictors to assess if associations differed between the ADHD group and LNCG, again controlling for follow-up age, sex, and MTA site. For all models that showed a significant association of any interaction term with outcome s, additional exploratory post hoc analyses were carried out.[19]

Statistical analyses were conducted with R software, version 3.2.4. Missing data patterns were analysed using the *VIM* package and multiple imputation was performed using the *mice* package. All tests were two-tailed. The Benjamini-Hochberg False Discovery Rate (FDR)[20] was applied to results from composite regression models (in step 2 and 3) to account for multiple testing. The threshold for statistical significance to control for proportion of false discoveries was set at *p* 0.05.

RESULTS

Occupational functioning

An increase in childhood household income level (OR = . 85, p <.001) and IQ (OR = .99, p = .014) were associated with a reduced likelihood of receiving public assistance in adulthood, while higher baseline ADHD symptom severity (OR = 1.50, p = .002) was associated with an increased likelihood of receiving public assistance. Job changes, operationalized as the number of times fired or quit, was predicted by a high baseline IQ (OR = 1.01, p < .001) and a high baseline ADHD severity (OR = 1.20, p < .001). A high household income (OR = 1.07, p = .011), high IQ (OR = 1.01, p = .002) and low comorbidity (OR = 0.86, p = .001) was associated with higher adult income level (table 1).

Emotional functioning

High comorbidity (B = .06, p < .001), high ADHD symptom severity (B = .19, p < .001), and harsh discipline (B = .05, p = .031) were associated with higher adult emotional lability scores. A higher IQ was associated with a greater risk for mood disorders (OR = 1.02, p = . 018) and a lower likelihood of neuroticism (B = −.005, p < .001). Neuroticism was also predicted by high comorbidity (B = .03, p = .01), possessive/protective parenting style (B = . 07, p = .025) and lack of parental affection and admiration (B = .15, p < .001). No baseline factor was associated with adult anxiety (table 1).

Educational attainment

Increase in parental monitoring (OR = 1.40, CI = 1.13 – 1.96, p = .004), parental education levels (OR = 1 .58, p < .001), and IQ (OR = 1.02, p < .001) were associated with an increase d likelihood of receiving a bachelor's degree. Increase in baseline ADHD symptom severity (OR = 0.69, p = .002) and parental marital problems (OR = 0.75, p = .032) were associated with a reduced likelihood of receiving a bachelor's degree (table 1).

Sexual behavior

Higher childhood household income (B = .11, p = .01), and number of household members (B = .17, p = .031) were associated with a n older age at first sexual contact. High baseline ADHD symptom severity was associated with a younger age at first sexual contact (B = −.50, p <.001). High baseline ADHD symptom severity (OR = 1.17, p < .001), a nurturing and intimate parent-child relationship (OR = 1.10, p = .006) and increased parental marital problems (OR = 1.03, p = .001) were associated with a risk of increase in total number of sexual partners. Positive parenting (OR = 0.93, p = .017) and higher numbers of household members (OR = 0.92, p < .001) were associated with a reduction in total sexual partners (table 1).

Predictor-by-group interactions showed that effects of parental marital problems (OR = 1.18, p < .001) on total number of sexual partners differed for the ADHD group and the LNCG. An increase in parental marital problems was associated with a risk of increase in total sexual partners in both groups, but this association was stronger in the LNCG (OR = 1.20, p < .001) than the ADHD group (OR = 1.02, p = .044).

Justice involvement

A low childhood household income (OR = 0.87, p = .005) and conflicting parent-child relationship (OR = 1.41, p = .02) was associated with an increased likelihood of police contact by adulthood (table 1).

Sensitivity analyses

To determine if comorbidity type (assessed with DISC-P reports) influenced outcomes, we assessed effects of baseline internalizing (any mood or anxiety disorder) and externalizing disorders (oppositional defiant or conduct disorder) on adult functioning. Models from the main analysis were re-run, replacing 'total number of comorbidities' with 'internalizing' or 'externalizing' disorders as baseline predictors. Results from the model selection step were comparable for outcomes of emotional lability, age at first sexual contact, public assistance, police contact, bachelor's degree, job changes, mood disorders, and anxiety disorders in adulthood (see supplementary material, table S2). In contrast to the main analysis, baseline internalizing or externalizing problems did not show associations with total sexual partners, adult income, and neuroticism in the model selection step. Results from the composite model for emotional lability outcome showed associations of internalizing (B = .15, SE = .04, p < .001) and externalizing disorders (B = 0.17, SE = .04, p < .001) with high emotional lability scores. Effects of harsh parenting and ADHD symptoms on emotional lability were comparable to results from the main analysis.

In a previous paper, we showed parental mental health to be an important determinant of adult ADHD persistence.[4] As information on baseline parental mental health was not available for the control group, we analyzed the impact of parental mental health problems separately in the ADHD subgroup. We used the total number of parental mental health problems (from either mother or father, whichever was higher) assessed with the Structured Clinical Interview for DSM Disorders–Non Patient (SCID-NP).[21] Composite models were re-run in the ADHD subset, including parental mental health problems as an additional

predictor. Results showed associations of higher parental mental health problems with higher emotional lability scores (B = .04, p = .012), lower age at first sexual contact (B = −.19, p = .023), greater risk for receiving public assistance (OR = 1.18, p = .034), higher job changes (OR = 1.07, p = .014), higher risk for mood disorders (OR = 1.28, p = .007), and higher neuroticism scores (B = 0.05, p = .021).

As the assumption of missing at random (MAR) cannot be conclusively established, we also analyzed the complete case dataset. Results were largely comparable to those from the imputed dataset (supplementary material, table S3). Additional effects found were: associations of conflicting parent-child relationship with a reduced likelihood of public assistance, associations of high IQ, high comorbidity, parental involvement and a possessive/ protective parent-child relationship with a reduced number of sexual partners, and associations of conflicting parent-child relationship with an increased number of partners. The following associations were no longer significant: baseline IQ and public assistance, childhood household income and adult income levels, harsh discipline and emotional lability, baseline IQ and adult mood disorders, childhood comorbidity and adult neuroticism, parental monitoring and adult educational attainment.

DISCUSSION

Effects of childhood factors on adult outcomes were generally comparable for the ADHD and control groups. This is partly reassuring as, given supportive environments, functioning may be improved in individuals with ADHD to a similar extent as those with no ADHD. However, functioning is known to be worse in ADHD and the more negative adult outcomes may be a consequence of ADHD symptom severity throughout development. Furthermore, functioning levels throughout development, and not just at one time-point in childhood, may influence outcomes.

The most important childhood predictors of adult outcome were household income, IQ and ADHD symptom severity. These factors influenced educational, emotional, occupational, sexual behavior and police involvement outcomes in adulthood. Of the three, ADHD severity showed stronger associations with functional outcomes, while the effects of household income and IQ were weaker. Our results suggest that early management of ADHD symptoms may attenuate adult functioning difficulties. Further, children with lower IQ and from households with low family income may require additional attention and assistance academically, socially, and emotionally.

Educational attainment clearly affects later functioning, especially occupational outcomes, and thus determining predictors of educational outcomes is highly relevant. We found that IQ, parental education, parenting style (monitoring and supervision), parental marital problems and ADHD severity influenced adult educational attainment. Therefore, problems in any of these areas early on may impact educational attainment, thereby affecting overall quality of life. These results also indicate that guiding parents in monitoring and supervision practices may aid academic outcomes.

It is of interest that parental marital problems were associated with poor educational attainment and an increased number of sexual partners, though the later association was more pronounced in the LNCG than the ADHD group. Here again, early family interventions addressing marital problems may decrease risk for multiple sexual partners in offspring and improve educational outcomes. Apart from parental marital difficulties, parental mental health problems (tested only in the ADHD subgroup) also seem to predict a number of poor functional outcomes, such as high emotional lability, neuroticism, and mood disorders as well as risk for early sexual initiation and public assistance. Just like marital problems, parental mental health issues may be amenable to interventions and thereby improve adult functioning in offspring with ADHD.

While considering effects of comorbidity on functional outcomes, it may be important to recognize that both total number of comorbidities and type of comorbidity influence functioning, and in unique ways. Our results show that presence of any internalizing or externalizing problem predicts adult emotional lability, while a higher number of comorbidities predict adult income levels and neuroticism in addition to emotional lability.

In our analytical models, we noted that the inclusion of multiple, albeit pre-screened factors washed out several associations. For example, inclusion of demographic predictors cancelled effects of family factors on public assistance and early initiation of sexual contact, suggesting that perhaps effects of family functioning are moderated by demographic features. Similarly, household income did not influence emotional lability or educational attainment when other factors were considered. Future studies may assess if moderating and mediating pathways exist between these childhood factors and their effects on adult outcomes.

Some unexpected associations require mention. We found higher IQ to predict greater job changes. We speculate that since job changes included both being fired and voluntarily quitting, those with higher IQ may be able to change jobs more frequently for better prospects, and which is reflected in the higher income levels of these individuals. Further, nurturing parent-child relationship was associated with a higher number of sexual partners in adulthood. The apparent negative effects of a nurturing relationship may reflect its influence on other functions, such as improved peer functioning and higher social involvement, and which in turn increase chances of sexual contact. Lastly, high baseline IQ increased risk for adult mood disorders, and which may reflect a greater awareness in these individuals of their problems.

Generally, the clinical implications of our predictive findings suggest that addressing ADHD symptomatology and providing additional support to children with lower IQs may benefit adult outcomes. In addition, better adult functional outcomes may be promoted by improving parenting practices through family interventions, addressing marital problems, and supporting families with low household incomes.

Limitations to this study include the assessment of functioning at a single time point in adulthood. Functioning difficulties in certain domains, such as education and behavior, may be influenced by impairments (or adaptation to such impairments) in adolescence. Second,

we relied on self-reports of functioning levels, which may have produced positively biased estimates. Third, several associations between childhood factors (especially baseline IQ) and adult outcomes, although statistically significant, had small effect sizes and therefore must be interpreted with caution. Further, we tested a large number of associations, and although corrected for multiple comparisons, it is imperative that these preliminary results be replicated in future studies.

In sum, childhood functioning and environments have modest effects on adult outcomes in individuals with ADHD. Early identification and modification of poor environmental factors and functioning may therefore aid in reducing the burden of ADHD in adulthood. It should be stressed that although we assessed effects of environmental factors singly, this rarely is the case in real life wherein multiple factors may act in concert to supplement the risk for a particular functional outcome. As has been noted by Weiss and Hechtman,[22] associated childhood functioning difficulties are more likely to cause impairments in quality of life of individuals with ADHD than the symptoms of ADHD itself. Thus, it is imperative that further research as well as clinical attention be directed to the early detection and appropriate management of factors that influence functional adult outcomes in ADHD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

References

1. Klein RG, Mannuzza S, Olazagasti, et al. Clinical and functional outcome of childhood attention-deficit/Hyperactivity disorder 33 years later. Arch Gen Psychiatry. 2012; 69(12):1295. [PubMed: 23070149]

2. Kuriyan AB, Pelham WE, Molina BSG, et al. Young adult educational and vocational outcomes of children diagnosed with ADHD. J Abnorm Psychol. 2012; 41(1):27–41.

3. Hechtman L, Swanson JM, Sibley MH, et al. Functional adult outcomes 16 years after childhood diagnosis of attention-deficit/Hyperactivity disorder: MTA results. J Am Acad Child Adolesc Psychiatry. 2016; 55(11):945–952. e2. [PubMed: 27806862]

4. Roy A, Hechtman L, Arnold LE, et al. Childhood factors affecting persistence and desistence of attention-deficit/hyperactivity disorder symptoms in adulthood: results from the MTA. J Am Acad Child Adolesc Psychiatry. 2016; 55(11):937–944. [PubMed: 27806861]

5. Jensen PS, Arnold LE, Swanson JM, et al. 3-Year follow-up of the NIMH MTA study. J Am Acad Child Adolesc Psychiatry. 2007; 46(8):989–1002. [PubMed: 17667478]

6. Molina BSG, Hinshaw SP, Swanson JM, et al. The MTA at 8 years: Prospective follow-up of children treated for combined-type ADHD in a Multisite study. J Am Acad Child Adolesc Psychiatry. 2009; 48(5):484–500. [PubMed: 19318991]

7. MTA Cooperative Group. A 14-Month Randomized clinical trial of treatment strategies for attention-deficit/Hyperactivity disorder. Arch Gen Psychiatry. 1999; 56(12):1073. [PubMed: 10591283]

8. MTA Cooperative Group. National institute of mental health Multimodal treatment study of ADHD follow-up: Changes in effectiveness and growth after the end of treatment. Pediatrics. 2004; 113(4): 762–769. [PubMed: 15060225]

9. Wells KC, Epstein JN, Hinshaw SP, et al. Parenting and family stress treatment outcomes in attention deficit hyperactivity disorder (ADHD): An empirical analysis in the MTA study. J Abnorm Psychol. 2000; 28(6):543–553.

10. Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME. NIMH diagnostic interview schedule for children version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. J Am Acad Child Adolesc Psychiatry. 2000; 39(1):28–38. [PubMed: 10638065]

11. Swanson, JM. School-Based Assessments and Treatments for ADD Students. KC publishing; 1992.

12. Taber SM. The veridicality of children's reports of parenting: A review of factors contributing to parent–child discrepancies. Clin Psychol Rev. 2010; 30(8):999–1010. [PubMed: 20655135]

13. Macey, K. Conners' adult ADHD rating scales (CAARS). Conners, CK.Erhardt, D., Sparrow, MA., editors. New York: Multihealth systems, Inc; 1999. Arch Clin Neuropsychol. 2003; 18(4):431–437.

14. Costa PT, McCrae RR. The revised neo personality inventory (neo-pi-r). The SAGE handbook of personality theory and assessment. 2008; 2:179–198.

15. Hinshaw SP, Owens EB, Wells KC, et al. Family processes and treatment outcome in the MTA: Negative/ineffective parenting practices in relation to multimodal treatment. J Abnorm Psychol. 2000; 28(6):555–568.

16. Buuren S, van Groothuis-Oudshoorn K. Mice: Multivariate imputation by chained equations in R. J Stat Softw. 2011; 45(3)

17. Rubin, DB. Multiple imputation for Nonresponse in surveys. John Wiley; Jun 9. 2004

18. Kaplow JB, Curran PJ, Dodge KA. Conduct Problems Prevention Research Group. Child, parent, and peer predictors of early-onset substance use: A multisite longitudinal study. J Abnorm Psychol. 2002; 30(3):199–216.

19. Holmbeck GN. Post-hoc probing of significant Moderational and Mediational effects in studies of pediatric populations. J Pediatr Psychol. 2002; 27(1):87–96. [PubMed: 11726683]

20. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc Series B Stat Methodol. 1995:289–300.

21. Spitzer RL, Williams JB, Gibbon M, et al. The structured clinical interview for DSM-III-R (SCID): I: history, rationale, and description. Arch Gen Psychiatry. 1992; 49(8):624–629. [PubMed: 1637252]

22. Weiss, G., Hechtman, T. Hyperactive children grown up: Empirical findings and theoretical considerations. 2. New York: Guilford Publications; Dec 25. 1986

CLINICAL GUIDANCE

1. Better adult functional outcomes in ADHD may be promoted by improving parental monitoring and supervision practices and by addressing marital problems through family interventions

2. Families of children with ADHD and with low household incomes may require additional support in order to attenuate future functional difficulties

3. Addressing ADHD symptoms early and in an ongoing manner may improve adult outcomes

4. Additional support to children with lower IQ, perhaps through special education, interventions for social skills training etc., may also improve adult functional outcomes

Table 1

Results from regressions of functional outcomes on selected baseline factors controlling for age at follow-up, sex, and MTA[a] site using imputed dataset

BASELINE FACTORS	OUTCOMES		
	Occupational functioning		
	Public assistance OR[b] (SE)[cd], p	Job changes OR (SE), p	Income levels OR (SE), p
Household income	0.85 (.04), <.001	_e	1.07 (.02), .011
Parental education	-	-	-
Total household members	-	-	-
IQ	0.99 (.007), .014	1.01 (.002), .001	1.01 (.004), .002
Comorbidity	-	-	0.86 (.04), .001
ADHD[f] symptom severity	1.50 (.13), .002	1.20 (.04), <.001	-
Parenting styles			
Positive parenting	-	-	-
Inconsistent discipline	-	-	-
Low monitoring and supervision	-	-	-
Harsh discipline	-	-	0.92 (.07), .25
Appropriate discipline	-	-	-
Parental involvement	-	-	-
Parent-child relationships			
Possessive and protective	-	-	-
Affectionate and admiring	-	-	1.15 (.10), 0.17
Conflicting	-	-	
Nurturing and intimate	-	-	
Participating and involved	-	-	
Parental marital problems	-	-	

BASELINE FACTORS	Emotional functioning			
	Emotional lability B (SE), p	Mood disorders OR (SE), p	Anxiety disorders OR (SE), p	Neuroticism B (SE), p
Household income	−0.01 (.01), .21	-	-	-
Parental education	-	-	-	-
Total household members	-	-	-	-
IQ	-	1.02 (.008), .018	-	−0.005 (.001), <.001
Comorbidity	0.06 (.01), <.001	-	-	0.03 (.01), .01

BASELINE FACTORS	OUTCOMES		
	Occupational functioning		
	Public assistance OR[b] (SE)[cd], p	Job changes OR (SE), p	Income levels OR (SE), p
ADHD symptom severity	0.19 (.02), <.001	-	-
Parenting styles			
Positive parenting	-	-	-
Inconsistent discipline	-	-	-
Low monitoring and supervision	-	-	-
Harsh discipline	0.05 (.02), .031	-	-
Appropriate discipline	-	-	-
Parental involvement	-	-	-
Parent-child relationships			
Possessive and protective	-	-	0.07 (.03), .025
Affectionate and admiring	-	-	−0.15 (.04), <.001
Conflicting	-	-	-
Nurturing and intimate	-	-	-
Participating and involved	-	1.16 (.14), .28	-
Parental marital problems	-	-	-

	Educational attainment (Bachelor's degree) OR (SE), p
Household income	1.07 (.04), .06
Parental education	1.58 (.09), <.001
Total household members	-
IQ	1.02 (.006), <.001
Comorbidity	-
ADHD symptom severity	0.69 (.11), .002
Parenting styles	
Positive parenting	-
Inconsistent discipline	-
Low monitoring and supervision	0.71 (.14), .013
Harsh discipline	-
Appropriate discipline	-
Parental involvement	-
Parent-child relationships	
Possessive and protective	-

BASELINE FACTORS	OUTCOMES		
	Occupational functioning		
	Public assistance OR[b] (SE)[cd], p	**Job changes** OR (SE), p	**Income levels** OR (SE), p
Affectionate and admiring		-	
Conflicting		-	
Nurturing and intimate		-	
Participating and involved		-	
Parental marital problems		0.75 (.13), .032	

	Sexual behavior	
	Age at 1st sexual contact B (SE), p	Total sexual partners OR (SE), p
Household income	0.11 (.04), .011	0.99 (.01), .36
Parental education	0.20 (.11), .06	-
Total household members	0.17 (.07), .031	0.92 (.01), <.001
IQ	0.004 (.01), .59	-
Comorbidity	-	0.97 (.01), .05[g]
ADHD symptom severity	−0.50 (.12), <.001	1.17 (.03), <.001
Parenting styles		
Positive parenting	-	0.93 (.03), .017
Inconsistent discipline	-	-
Low monitoring and supervision	-	-
Harsh discipline	-	-
Appropriate discipline	-	-
Parental involvement	-	0.94 (.03), .06
Parent-child relationships		
Possessive and protective	−0.24 (.13), .06	-
Affectionate and admiring	-	-
Conflicting	-	1.06 (.03), .049[h]
Nurturing and intimate	-	1.10 (.03), .006
Participating and involved	-	-
Parental marital problems	−0.02 (.07), .77	1.03 (.01), .001

	Justice involvement (Police contact) OR (SE), p
Household income	0.87 (.04), .005
Parental education	-

BASELINE FACTORS	OUTCOMES		
	Occupational functioning		
	Public assistance OR[b] (SE)[cd], p	Job changes OR (SE), p	Income levels OR (SE), p
Total household members		-	
IQ		-	
Comorbidity		-	
ADHD symptom severity		1.29 (.15), .09	
Parenting styles			
Positive parenting		-	
Inconsistent discipline		-	
Low monitoring and supervision		-	
Harsh discipline		-	
Appropriate discipline		-	
Parental involvement		-	
Parent-child relationships			
Possessive and protective		-	
Affectionate and admiring		-	
Conflicting		1.41 (.15), .02	
Nurturing and intimate		-	
Participating and involved		-	
Parental marital problems		-	

[a]Multimodal treatment study of ADHD

[b]Odds ratio

[c]Standard error

[d]Standard errors are reported for log-odds (not the Odds Ratios) and B-values

[e]Blanks represent predictor-outcome associations that were not significant in the model selection step and hence these predictors were not included in the composite models

[f]Attention-Deficit/Hyperactivity Disorder

[g]Did not retain significance after applying the False Discovery Rate for multiple testing

[h]Did not retain significance after applying the False Discovery Rate for multiple testing