

Supplemental Table S1. Characteristics of participants in the Healthy Start cohort, the pilot study, and the final analytic sample

	Entire cohort (n=1,410)	Subset with cannabinoids measured in urine samples (n=199)	Analytic sample (n=81)
Mother characteristics			
Age (years)	28±6	30±6	30±6
Pre-pregnancy body mass index (kg/m ²)	26±6	25±5	26±5
Gestational weight gain (kg)	13±7	13±6	13±6
Race/Ethnicity			
Non-Hispanic White	53%	57%	59%
Non-Hispanic Black	15%	11%	4%
Hispanic	25%	25%	31%
Other	6%	8%	6%
Highest level of education			
<High school	14%	10%	12%
High school degree	18%	16%	14%
Some college or more	67%	74%	74%
Household income			
<\$40,000	29%	25%	22%
\$40,001 to \$70,000	19%	15%	11%
≥\$70,000	32%	44%	51%
Don't know	20%	15%	16%
Maternal diagnosis of psychiatric illness			
Yes	18%	14%	7%
No	82%	86%	91%
Child characteristics			
Male	52%	49%	48%
Birthweight (grams)	3,204±537	3266±557	3319±383
Gestational age (weeks)	39±2	39±2	40±1
Exclusively breastfed at age 5 months			
Yes	-	52%	57%
No	-	49%	42%
Early-life exposure to cannabis			
Fetal exposure to cannabis			
Yes	-	13%	7%
No	-	87%	93%
Childhood exposure to cannabis			
Yes	-	19%	12%
No	-	81%	88%

Supplemental Table S2. Fetal exposure to cannabis and offspring cognition: Scoping review of literature

Reference	Lead author	Study description (n)	Exposure assessment	Outcome assessment	Fetal exposure to tobacco	Other covariates	Effect
8	Richardson et al (1995)	USA (MHPCD), 9 months (n=520)	Self-report	Bayley Scales of Infant Development (BSID)	Covariate	Examiner, age at examination, current work/school status (other variables removed via stepwise regression)	Lower mental development scores
9	Day et al (1994)	USA (MHPCD), 18 to 36 months (n=655)	Self-report	Stanford-Binet Intelligence Scale (SBIS)	Considered as a covariate	Covariates not specified	Impaired short-term memory; Lower composite scores
10	Goldschmidt et al (2008)	USA (MHPCD), 6 years (n=648)	Self-report	SBIS	Considered as a covariate	Maternal cognitive ability, social support, race, number of people in household, Home Screen Questionnaire, Alcohol Problems of man in household, number of illnesses, maternal depression, number of siblings (final covariates determined via stepwise regression)	Impaired verbal reasoning, quantitative reasoning, and short-term memory; Lower composite scores
11	Richardson et al (2009)	USA, 3 years (n=263)	Self-report	SBIS	Considered as a covariate	Race, child sex, Home Screen Questionnaire, hostility, alcohol/tobacco/illicit drug use during pregnancy, maternal depression, number of siblings (final covariates determined via stepwise regression)	Impaired abstract/verbal reasoning; Lower composite score
12	Fried et al (2000)	Canada (OPPS), 9 to 12 years (n=146)	Self-report	Test of Visual-Perceptual Skills	Considered as a covariate	Covariates not specified	Lower scores on perceptual organization index
13	Rose-Jacobs et al (2011)	USA (BHUS) 12 to 14 years (n=137)	Biomarkers (maternal or infant urine, or meconium) and self-report	Delis-Kaplan Executive Function System	Covariate	IQ, gender, prenatal cocaine/alcohol/tobacco use, own use of cannabis/cocaine/alcohol/tobacco	Impaired design fluency total correct switching condition scores

14	Smith et al (2004)	Canada (OPPS), 18 to 22 years (n=31)	Self-report	fMRI during Go/No-Go task	Covariate	Prenatal nicotine/ alcohol/caffeine exposure and current cannabis/nicotine/alcohol considered as covariates (depending on the analysis)	Changes in neural activity during response inhibition
15	Lewis et al (2004)	USA (CWRUS), 4 years (n=374)	Detection of THC in urine immediately before or after delivery	Clinical Evaluation of Language Fundamentals—Preschool	Not included as a covariate or effect modifier	Unadjusted	Poorer scores on measure of formulating labels
16	Fried et al (2003)	Canada (OPPS), 13 to 16 years (n=31)	Self-report	Wisconsin Card Sorting Test (WCST); Wide Range Achievement Test (WRAT); Wechsler Intelligence Scale for Children (WISC); Peabody Individual Achievement Test (PIAT); Stroop test	Covariate	Covariates not specified (final covariates determined using stepwise Discriminant Function Analysis)	Lower spelling recognition scores and slower response times on a visual memory test
17	Richardson et al (2002)	USA (MHPCD), 10 years months (n=592)	Self-report	WCST; Connor's Continuous Performance Test (CPT-II); Wide Range Assessment of Memory and Learning (WRAML); Trail Making Test	Considered as a covariate	Maternal cognitive ability, social support, race, number of people in household, Home Screen Questionnaire, Alcohol Problems of man in household, number of illnesses, maternal depression, number of siblings, cocaine/tobacco/alcohol use during pregnancy (final covariates determined via stepwise regression)	Poorer performance on composite index and design memory (WRAML); More commission errors (CPT-II)
18	Singer et al (2005)	USA (CWRUS) 6 and 12 months (n=352)	THC measured in maternal or infant urine; self-report	Visual recognition memory	Covariate	Maternal age, parity, number of prenatal care visits, maternal years of education, marital status, socioeconomic status, biologic and current caregiver, PPVT/picture completion/WAIS scores, non-maternal care status,	Shorter average looking times

						psychological distress and prenatal/current caregiver use of cigarette/alcohol/cannabis (final covariates determined via stepwise regression)	
19	Singer et al (2008)	USA (CWRUS), 9 years (n=371)	THC measured in maternal or infant urine; self-report	WISC; Woodcock-Johnson III Tests of Achievement	Unknown	Covariates not specified	Slower processing speed
20	Goldschmidt et al (2004)	USA (MHPCD), 10 years months (n=606)	Self-report	WRAT; PIAT	Unknown	Not clear if means presented are adjusted	Lower academic achievement
21	Goldschmidt et al (2012)	USA (MHPCD), 14 years months (n=524)	Self-report	Wechsler Individual Achievement Test (WIAT)	Not included as a covariate or effect modifier	Race, maternal education, gender, number of siblings, family income, Home Observation for Measurement of the Environment (HOME) scale; (Final covariates determined via stepwise regression)	Lower academic achievement
22	Paul et al (2021)	USA (ABCD study), 10 years, (n=11,875)	Retrospective report of cannabis use (before/after knowledge of pregnancy)	NIH Toolbox Cognition Battery	Covariate (measured before and after knowledge of pregnancy)	Maternal alcohol and tobacco use during pregnancy, maternal race and ethnicity, child sex, child age at follow up, household income, maternal education, maternal age at delivery, unplanned pregnancy, birth weight, family history of depression, mania, antisocial disorder, or anxiety, childhood alcohol or tobacco use, and singleton/multiple birth.	Lower cognition composite scores
23	Fried and Watkinson (1988)	Canada (OPPS), 1 and 2 years (n=370)	Self-report	BSID	Covariate	Covariates not specified	Higher cognition scores
24	Fried et al (1998)	Canada (OPPS), 9 to 12 years (n=131)	Self-report	WISC-III; Fluency Test; Auditory Working Memory; Tactual	Covariate	Covariates not specified (final covariates determined using stepwise Discriminant Function Analysis)	Poorer scores on WISC-III object assembly subscales

				Performance Task; Category Test			
25	Willford et al (2010)	USA (MHPCD) 16 years (n=320)	Self-report	Bimanual Coordination Test	Covariate	Sex, race, maternal cognitive ability, education, marital status, social support, number of people in household, Home Screen Questionnaire, Alcohol Problems of man in household, number of illnesses, maternal depression, number of siblings, cocaine/tobacco/alcohol use during pregnancy (final covariates determined via stepwise regression)	Better performance on measure of visuomotor coordination
26	Fried and Watkinson (1990)	Canada (OPPS), 3 and 4 years (n=133)	Self-report	McCarthy's Scales of Children's Abilities (MSCA), Reynell	Considered as a covariate and effect modifier	Family income, mother's weight and pregnancy weight gain, age, education, nutrition, drug use, sex, parity, gestation, birth weight, HOME scale (final covariates not specified)	Better motor performance
27	Rose-Jacobs et al (2012)	USA (BHUS) 11 years (n=119)	THC measured in maternal/infant urine or meconium; self-report	WIAT	Covariate	Birth mothers' country of origin (US born vs. not) and years of education at recruitment; children's gender and current custody arrangement, IQ and VEX-R scores	Better academic performance; poorer verbal and memory performance
28	Singer et al (1999)	USA (CWRUS) neonates (n=74)	THC measured in maternal/infant urine or meconium; self-report	Fagan test of infant intelligence	Covariate	Covariates not specified	No association (data not presented)
29	Singer et al (2002)	USA (CWRUS) 6, 12, 24 months (n=415)	THC measured in maternal/infant urine or meconium; self-report	BSID-II	Covariate	Covariates not specified	No association (data not presented)

30	Noland et al (2003a)	USA (CWRUS) 9-12 months (n=51)	THC measured in maternal or infant urine; self-report	A-not-B task; BSID-II	Covariate	Socioeconomic status, marital status, race, maternal age, years of education, weeks of gestation, birth weight, prenatal alcohol/tobacco/cocaine use	No association (data not presented)
31	Richardson et al (2008)	USA (MHPCD) 16 months (n=261)	Self-report	BSID	Covariate	Child age, developmental stimulation, race, prenatal alcohol/tobacco/cocaine use, man in household, number of children in household, number of hospitalization, current cannabis use	No association
32	Hayes et al (1991)	Jamacia (UMJS) 4 and 5 years (n=56)	Self-report	MSCA	Covariate		No association (data not presented)
33	O'Connell and Fried (1991)	Canada (OPPS) 6 to 9 years (n=56)	Self-report	WISC; WRAT; Stroop Test; Test of Visual Perceptual Skills; Trail making test (Part A); Developmental Test of Visual-Motor Integration	Covariate	Sociodemographic information, child's health, school progress, family size, birth order, principal language spoken at home and school, home environment, mother's personality and intelligence (final covariates determined using stepwise Discriminant Function Analysis)	No association
34	Fried et al (1992)	Canada (OPPS) 6 years (n=126)	Self-report	MSCA; Gordon delay task; Gordon vigilance task	Covariate	Covariates not specified (final covariates determined using stepwise Discriminant Function Analysis)	No association (data not presented)
35	Noland et al (2003b)	USA (CWRUS), 4 years (n=316)	THC measured in maternal or infant urine; self-report	MSCA; Motor-planning task; Tapping inhibition task; Category fluency subtest	Covariate	Maternal age, current cocaine/tobacco/alcohol use, prenatal cocaine/tobacco/alcohol use, verbal IQ	No association
36	Frank et al (2005)	USA (BHUS) 4 years (n=208)	THC measured in maternal/infant urine or meconium; self-report	Wechsler Preschool and Primary Scale of Intelligence (WPPSI)	Covariate	Prenatal cocaine, alcohol, and tobacco exposure, maternal education, birth weight, intervention at 48 months, caregiver at 48 months, caregiver's history of drug	No association

						treatment, history of homelessness.	
37	Noland et al (2005)	USA (CWRUS), 4 years (n=301)	THC measured in maternal or infant urine; self-report	CPT; Peripheral Detection Task (PDT)	Not included as a covariate or effect modifier	Prenatal exposure to cocaine, caregiver current use of cannabis	No association
38	Beeghly et al (2006)	USA (BHUS) 6 and 9 years (n=160)	Self-report	Test of Language Development-Primary (TOLD-P3); Clinical Evaluation of Language Fundamentals (CELF)	Not specified	Covariates not specified	No association (data not presented)
39	Morrow et al (2006)	USA (UMSM) 7 years (n=476)	Self-report	WIAT; WISC-III	Covariate	Child sex, child age, child hearing, child education, HOME learning environmental scale, maternal age, maternal education, maternal employment, marital status, prenatal case, caregiver, caregiver employment/education, prenatal and postnatal exposure to cocaine, cannabis, tobacco, and alcohol.	Learning disabilities only among those with IQ > 70 condition
40	Mayes et al (2007)	USA (YCSC), 8 to 10 years (n=130)	Self-report	Groton maze learning test	Not specified	Not specified	No association (data not presented).
41	Bennett et al (2008)	USA (DRWJ), 4, 6, and 9 years (n=231)	Self-report	SBIS-IV	Covariate	Neonatal medical risk factors, stimulating environmental, maternal stress, maternal IQ, prenatal exposure to tobacco, alcohol, and cocaine, child age, child sex	No association
42	Carmody et al (2011)	USA (DRWJ), 6 years (n=203)	Self-report	Yale child study center attention task	Covariate	Medical complications, environmental risk, prenatal	No association

						exposure to tobacco, cocaine, and alcohol, child sex.	
43	Fried et al (1997)	USA (OPPS), 9-12 years (n=131)	Self-report	WISC-III; WRAT-R; Peabody Picture Vocabulary Test (PPVT); Woodcock Reading Mastery Test; Oral cloze test; Seashore rhythm test	Covariate	Family income, maternal age, maternal and paternal education, pre-pregnancy weight, maternal drug use, child sex, the home environment, the mother's personality, the child's level of depression and anxiety, and childhood exposure to tobacco or cannabis.	No association.
44	Hurt et al (2005)	USA (CHP), 10 years (n=135)	Self-report after delivery	Gordon distractibility task	Not included as a covariate or effect modifier.	Covariates determined through backwards selection. Prenatal and postnatal exposure to cocaine, foster care, HOME score, child IQ.	No association
45	Hurt et al (2009)	USA (CHP), 12 years (n=120)	Self-report after delivery	Counting Stroop test; Go/No-go task; PPVT; Cambridge Neuropsychological Test Automated Battery (CANTAB)	Covariate	Child age, child sex, prenatal exposure to cocaine, alcohol or cocaine, HOME scores, foster care, current caregiver cocaine use, duration of cocaine exposure during pregnancy.	No association
46	Lewis et al (2010)	USA (CWRUS), 10 years (n=350)	Self-report	TOLD-I3; Comprehensive Test of Phonological Processing (CTOPP)-2	Not included as a covariates or effect modifier	Bivariate associations.	No association
47	Day et al (2011)	USA (MHPCD) 10 years (n=580)	Self-report	SBIS	Covariate	Maternal self-report of cocaine, tobacco, and alcohol use during pregnancy, HOME scores, maternal cognitive ability, maternal depression and hostility, household income, maternal education, number of people in the household, child in maternal custody.	Not associated with learning, memory, or IQ after adjusting for covariates (data not presented).

48	Smith et al (2006)	Canada (OPPS) 18-22 years (n=31)	Self-report	fMRI during Modified n-back task; WISC; WAIS	Covariate	Prenatal nicotine, alcohol and caffeine exposure, current marijuana, alcohol and nicotine use and IQ	No association
49	Richardson et al (2015)	USA (MHPCD) 15 years (n=219)	Self-report	WISC-III	Covariate	Covariates determined by stepwise regression. Caregiver sociodemographic and psychosocial characteristics, offspring characteristics, current substance use, and prenatal substance use (cocaine, tobacco, alcohol).	No association
50	Smith et al (2016)	Canada (OPPS) 18-22 years (n=31)	Self-report	WAIS; fMRI during Modified n-back task; Go/No-go task; Counting Stroop test	Not included as a covariate or effect modifier	Current cannabis use in the offspring	No association
51	Smid et al (2021)	USA (MFMU Network), 4 years (n=1,197)	Detection of THC in urine (8-20 weeks gestation)	BSID-III	Not included as a covariate or effect modifier	Insurance type, education, race and ethnicity, and child age at examination	No association

Study names: ABCD study, Adolescent Brain and Cognitive Development Study; BHUS Boston and Harvard Universities Study; CHP Children’s Hospital of Philadelphia Study; CWRUS Case Western Reserve University Study; DRWJ, Drexel and Robert Wood Johnson Universities Study; MFMU Network, Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network; MHPCD, Maternal Health Practices and Child Development Study; OPPS, Ottawa Prenatal Prospective Study; UMJS, University of Miami’s Jamaican Study; UMSM, University of Miami School of Medicine Study; YCSC, Yale Child Study Center

Supplemental Table S3. Fetal exposure to cannabis and offspring behavior: Scoping review of literature

Reference	Lead author	Study description (n)	Exposure assessment	Outcome assessment	Fetal exposure to tobacco	Other covariates	Effect
22	Paul et al (2021)	USA (ABCD study), 10 years, (n=11,875)	Retrospective report of cannabis use (before/after knowledge of pregnancy)	CBCL	Covariate (measured before and after knowledge of pregnancy)	Maternal alcohol and tobacco use during pregnancy, maternal race and ethnicity, child sex, child age at follow up, household income, maternal	More internalizing, externalizing, attention, thought, social, and sleep problems.

						education, maternal age at delivery, unplanned pregnancy, birth weight, family history of depression, mania, antisocial disorder, or anxiety, childhood alcohol or tobacco use, and singleton/multiple birth.	
51	Smid et al (2021)	USA (MFMU Network), 4 years (n=1,197)	Detection of THC in urine (8-20 weeks gestation)	Conners' Rating Scales-Revised	Not included as a covariate or effect modifier	Insurance type, education, race and ethnicity, and child age at examination	Decreased attention scores
52	El Marroun et al (2011)	Netherlands (Generation R study), 18 months (n=4,077)	Self-report of use in first trimester	Child Behavior Checklist (CBCL)	Maternal cannabis users could also be concurrent tobacco users	Age of the child and maternal characteristics (education, ethnicity and psychopathology).	More aggressive behavior in female offspring
53	Stroud et al (2018)	USA (BAM BAM study), neonates (n=122)	Self-report	NICU Network Neurobehavioral Scale (NNNS)	Co-exposure	Varied (infant age, time since feeding, prenatal exposure to tobacco, postnatal exposure to tobacco, maternal depression, the duration of breastfeeding.	Co-exposure to cannabis and tobacco associated with decreased attention and ability to self-soothe
54	Fried, Watkinson, and Gray (1992)	Canada (OPPS), 6 years, (n=126)	Self-report	Gordan Diagnostic System	Covariate	Covariates not specified	Higher scores on impulsive/hyperactive scale and increased omission errors (reflecting decreased attention)

55	Goldschmidt et al (2000)	USA (MHPCD), 10 years (n=636)	Self-report in each trimester	CBCL, Swanson, Noland, and Pelham (SNAP), Teacher's Report Form (TRP)	Covariate	Maternal education, race, marital status, work/school, family income, maternal depression/hostility, alcohol and tobacco use during pregnancy	Increased hyperactivity, impulsivity, and inattention (SNAP); increased delinquency (CBCL); Increased delinquency and externalizing problems (CBCL).
56	Gray et al (2000)	USA (MHPCD), 10 years (n=636)	Self-report in each trimester	Children's Depression Inventory (CDI)	Not included as a covariate or effect modifier	Varied (childhood IQ, maternal tobacco use at age 10 years, childhood hospitalizations, HOME score, life events)	More depressive symptoms.
57	Leech et al (2006)	USA (MHPCD), 10 years (n=636)	Self-report	CDI, Revised Children's Manifest Anxiety Scale (RCMAS)	Covariate	Attention problems, household density, prenatal, injuries, and marijuana exposure.	Higher combined depression and anxiety score
58	Godleski et al (2018)	USA, 24 and 36 months (n=247)	Self-report in each trimester and biologically verified (maternal saliva and infant meconium)	Brief Infant Toddler Social Emotional Assessment (BITSEA)	Effect modifier	Demographic risk and child sex. Mediators included breastfeeding duration, maternal warmth/sensitivity and maternal affective dysregulation	No association
59	Larkby et al (2011)	USA, 16 years (n=592)	Self-report in each trimester	DSM-IV Diagnosis of Conduct Disorder	Covariate	Prenatal exposure to tobacco, marijuana, cocaine (& other illicit drugs), income, race, gender, parenting style, life events, home environment,	No association

						family history of alcohol, and maternal psychopathy	
60	Leech et al (1999)	USA (MHPCD), 6 years (n=636)	Self-report in the first trimester	Continuous Performance Task (CPT)	Covariate	Child characteristics, environmental characteristics, maternal characteristics, current maternal substance use, prenatal substance exposure	Second trimester cannabis use was associated with more errors of commission (reflecting impulsivity) and fewer omission errors (reflecting improved attention)
23	Fried and Watkinson (1988)	Canada (OPPS), 1 and 2 years (n= 370)	Self-report	Infant Behavior Record (IBR)	Covariate	Covariates not specified	No association
24	Fried et al (1998)	Canada (OPPS), 9 to 12 years (n=131)	Self-report	Gordon Vigilance Test	Covariate	Covariates not specified (final covariates determined using stepwise Discriminant Function Analysis)	Improved sustained attention (more correct responses and fewer commission errors)
61	Richardson et al (1989)	USA (MHPCD), neonates, (n= 373)	Self-report in each trimester	Neonatal Behavior Assessment Scale (NBAS)	Covariate	Birth weight, other substance use, infant age at exam, NBAS examiner	No association
62	de Moraes Barros et al (2006)	Brazil, neonates (n=561)	Cannabinoids measured in maternal hair and neonatal meconium analysis	NICU Network Neurobehavioral Scale (NNNS)	Excluded	Sex, gestational age at birth, postnatal age, and the product of gestational x postnatal age	Altered neurological performance at birth
63	Murnan et al (2021)	USA, 3.5 years, (n=63)	Self-report or detection of THC in maternal urine	Toy Behind Barrier task; Bobo Interaction task; Leifer-Roberts Response	Covariate	Child race, sex, prenatal tobacco exposure, household income, caregiver marital status, and	Associated with more aggression (Bobo task, CBCL), withdrawn symptoms, externalizing behaviors, and

				Hierarchy Questionnaire (LRRHQ); CBCL		caregiver executive functioning	oppositional defiant behaviors.
64	Hunter et al (2021)	USA, 4 years (n=83)	Self-report	CBCL	Not included as a covariate or effect modifier	Covariates not specified	More attention problems, sleep problems, social withdrawn problems, anxiety/depression, emotionally reactive, somatic complaints, aggressive behavior, and total problems.
65	Cioffredi et al (2022)	USA (ABCD), 9-10 years (n=672)	Retrospective report of cannabis use (before/after knowledge of pregnancy)	CBCL	Matched	Parental total problems, maternal age, months breastfed, prematurity, race and highest household education.	More externalizing behaviors, total problems, attention problems, and thought problems.
66	DiGuseppi et al (2022)	USA (SEED); 30-68 months (n=4,254)	Self-report	Diagnosis of Autism Spectrum Disorder	Covariate	SEED phase, child sex, maternal race/ethnicity, maternal education, and peri-pregnancy use of tobacco, alcohol, and other illicit drugs.	No association

Study names: ABCD study, Adolescent Brain and Cognitive Development Study; MFMU Network, Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network; MHPCD, Maternal Health Practices and Child Development Study; OPPS, Ottawa Prenatal Prospective Study; SEED, Study to Explore Early Development