To Smoke or Not to Smoke While Pregnant or Breastfeeding: What are the Consequences?

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AWHONN CA
February 22, 2020

Disclosures

I receive research funding from the following industry sponsors and a foundation: Amgen Inc.; Astra Zeneca; Bristol-Myers Squibb; Celgene; GlaxoSmithKline; Janssen Pharmaceuticals; Pfizer, Inc.; Regeneron; Hoffman La Roche-Genentech; Genzyme Sanofi-Aventis; Seqirus; Takeda Pharmaceutical Company Limited; UCB, USA; Sun Pharma Global FZE and the Gerber Foundation

Learning Objectives

- At the end of this session, attendees will be able to identify if exposure to marijuana during pregnancy is associated with an increased risk of birth defects, preterm delivery, growth deficiency and/or neurodevelopmental deficits

- Attendees will also be able to describe what is known about maternal marijuana use and breastfeeding and the potential impact on infant neurodevelopment due to these exposures

Cannabinoids

- Three forms of cannabinoids: phyto (plant), endo (within) and synthetic (manufactured)
- There are >100 unique phytocannabinoids in the Cannabis sativa plant along with terpenes (entourage/ensemble effects) and more than 500 other chemicals when combusted
- Most common is THC
- Most medically promising is cannabidiol (CBD) for conditions such as epilepsy; CBD not intoxicating but psychoactive

How Cannabis Works

Endocannabinoids
(Brain Derived)

Phytocannabinoids
(Plant Derived)

Synthetic Cannabinoids
(Made in Lab)

Endocannabinoid Receptors: CB1 & CB2

The endocannabinoid system (ECS) involved in regulating variety of physiological processes (appetite, pain/ pleasure sensation, immune system, mood, memory)

What is Marijuana/Cannabis?

- Dried flowering heads of the Cannabis sativa or indica plant cross breeds

- Known as: marijuana (in U.S. legislation), cannabis, pot, weed, ganja, dank, 420, grass, dope, bhang, hashish

- Potency of principal psychoactive cannabinoid delta 9 tetrahydrocannabinol (THC) is generally higher than ever before (15-25%) and greatly differs by preparation technique

Marijuana Use in Pregnancy

National Survey on Drug Use and Health 2007-2012

- 7.0% of pregnant respondents used in the last 2-12 months; 16.2% reporting almost daily use
- 92% of pregnant respondents thought access to marijuana was easy
- 70% of pregnant past-year users perceived slight or no risk of harm from using marijuana 1-2 times a week in pregnancy

Ko JY et al. *American Journal of Obstetrics and Gynecology*. 2015;213(2):201 e1- e10
ElSohly MA et al. *Biological Psychiatry*. 2016;79(7):613-9

Trends in California

Research Letter

December 26, 2017

Trends in Self-reported and Biochemically Tested Marijuana Use Among Pregnant Females in California From 2009-2016

Kelly C. Young-Wolff, PhD, MPH[1]; Lue-Yen Tucker, BA[1]; Stacey Alexeeff, PhD[1]; et al

» Author Affiliations

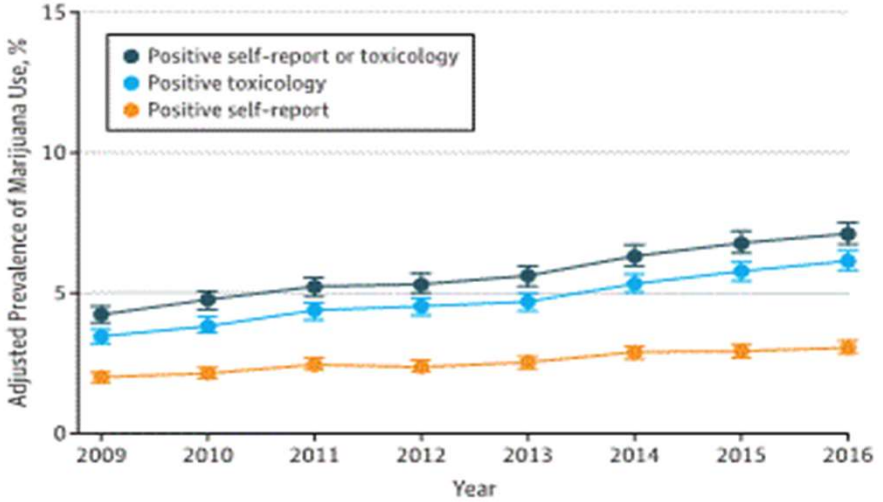
JAMA. 2017;318(24):2490-2491. doi:10.1001/jama.2017.17225

Marijuana is the most commonly used illicit drug during pregnancy, and its use is increasing. From 2002 to 2014, the prevalence of self-reported, past-month marijuana use among US adult pregnant women increased from 2.4% to 3.9%.[1] In aggregated 2002-2012 data, 14.6% of US pregnant adolescents reported past-month use.[2] However, studies are limited to self-reported surveys and likely underestimate use due to social desirability bias and underreporting, leaving the scope of the problem unclear. We investigated trends of prenatal marijuana use from 2009-2016 using data from a large California health care system with universal screening via self-report and urine toxicology.

Trends in California

- 241,952 pregnancies Kaiser Northern California
- From 2009-2016, increase in self-reported use across all age groups from 4.2% to 7.1%
- Highest increase seen in 18-24 year olds from 12.5% to 21.8%
- Higher in toxicology screened women
- Similar to increases seen in national data 2002-2014

Figure 1. Adjusted Prevalence of Marijuana Use Among 279 457 Pregnant Females in KPNC by Screening Type, 2009-2016



Young-Wolff KC, et al. *JAMA*. 2017;318(24):2490-91.
Brown QL, et al. *JAMA*. 2017;3187(2):207-209.

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Questions to Consider When Determining Whether a Drug is Teratogenic

- Does it cross the placenta? (Yes)
- Does it increase the risk for a baby to be…
  - born with a birth defect
  - born small
  - delivered prematurely
  - predisposed to learning or behavior problems

Bailey JR et al. *Toxicology Applied Pharmacology*. 1987;90(2):315-21.
Behnke M, Smith VC. *Pediatrics*. 2013;131(3):e1009–1024

Risk/Safety of Marijuana in Pregnancy

- 3 older prospective cohort studies
- 3 newer prospective cohort studies
- National Birth Defects Prevention retrospective study

Prospective Cohort Study 1

Ottawa Prospective Prenatal Study (OPPS)

- Middle class low risk Canadian cohort
- Predominately white, non-Hispanic
- Initiated 1978
- N = 420; N = 140 cannabis users in pregnancy
- Self-report cannabis use

Fried PA. *Life Sciences*. 1995;56 (23-24):2159-68

Prospective Cohort Study 2

Maternal Health Practice and Child Development Study (MHPCD)

- High risk, low SES
- Mixed white, African American
- Initiated 1982 Pittsburgh, PA
- N = 519; 279 cannabis users in pregnancy

Scher MS, et al. *Pediatric Research.* 1988;24(1):101-5

Prospective Cohort Study 3

Yale New Haven Hospital Study

- 3,357 pregnancies ending in singleton live births
- 1980-82
- 80% white; 20% non-white
- 4.1% used marijuana occasionally
- 5.4% used marijuana at least 2-3 times per month

Hatch EE and Bracken MB. *American Journal of Epidemiology.* 1986;124(6):986-93.

Prospective Cohort Study 4

Generation R Study – Rotterdam, the Netherlands

- Mixed ethnic cohort
- Enrolled 2001-2006
- N = 9,778; N = 214 cannabis users in pregnancy
- Self-report of cannabis use (subset with urine samples)

El Marroun H et al. *Drug and Alcohol Dependence.* 2011;118(2-3):470-4.

Prospective Cohort Study 5

Brisbane, Australia

- All deliveries of live born infants 2000-2006
- Mixed race/ethnicity; predominately white
- N=24,874; N = 637 cannabis users in pregnancy

Hayatbakhsh MR et al. *Pediatric Research.* 2012;71:215-219.

Prospective Cohort Study 6

SCOPE International Consortium

- Live born infants born to first-time mothers in centers in Australia, New Zealand, Ireland and UK
- 2004-2011
- Predominately white
- N = 5,588; N = 220 cannabis users in pregnancy

Leemaqz SY et al. *Reproductive Toxicology*. 2016;62:77-86.

Case Control Study

National Birth Defects Prevention Study (1997-2005)

- Interviews after birth regarding prenatal exposures
- Mothers of 13,859 cases with one or more of 20 specific birth defects
- Mothers of 6,556 non-malformed infants interviewed after birth

Van Gelder MM et al. *Paediatric and Perinatal Epidemiology.* 2014;28:424-433.

Major Birth Defects

Using Bayesian Models to Assess the Effects of Under-reporting of Cannabis Use on the Association with Birth Defects, National Birth Defects Prevention Study, 1997–2005

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Abstract

Background: Studies on associations between periconceptional cannabis exposure and birth defects have mainly relied on self-reported exposure. Therefore, the results may be biased due to under-reporting of the exposure. The aim of this study was to quantify the potential effects of this form of exposure misclassification.

Methods: Using multivariable logistic regression, we re-analysed associations between periconceptional cannabis use and 20 specific birth defects using data from the National Birth Defects Prevention Study from 1997–2005 for 13 859 case infants and 6556 control infants. For seven birth defects, we implemented four Bayesian models based on various assumptions concerning the sensitivity of self-reported cannabis use to estimate odds ratios (ORs), adjusted for confounding and under-reporting of the exposure. We used information on sensitivity of self-reported cannabis use from the literature for prior assumptions.

Results: The results unadjusted for under-reporting of the exposure showed an association between cannabis use and anencephaly (posterior OR 1.9 [95% credible interval (CRI) 1.1, 3.2]) which persisted after adjustment for potential exposure misclassification. Initially, no statistically significant associations were observed between cannabis use and the other birth defect categories studied. Although adjustment for under-reporting did not notably change these effect estimates, cannabis use was associated with esophageal atresia (posterior OR 1.7 [95% CRI 1.0, 2.9]), diaphragmatic hernia (posterior OR 1.8 [95% CRI 1.1, 3.0]), and gastroschisis (posterior OR 1.7 [95% CRI 1.2, 2.3]) after correction for exposure misclassification.

Conclusions: Under-reporting of the exposure may have obscured some cannabis birth defect associations in previous studies. However, the resulting bias is likely to be limited.

Van Gelder MM et al. *Paediatric and Perinatal Epidemiology.* 2014;28:424-433.

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Major Birth Defects

Other single site/state case-control or birth defects registry studies have shown

- increased risks for a wide range of defects
- increased risk for ventricular septal (heart) defects
- no increased risk for neural tube defects

Forrester MB and Merz RD. *Journal of Toxicology and Environmental Health Part A* 2007;70:7-18.
Williams LJ et al. *Birth Defects Research (Part A).* 2004;70:59-64
Shaw GM et al. *American Journal of Epidemiology.* 1996;144:1155-60.

Summary: Major Birth Defects

- Very limited data
- Most studies not large enough or not focused on studying risk for major birth defects
- Some suggestion of modest increased risks for specific birth defects (Odds Ratios <2) from largest case-control study
- Could be due to chance, or unmeasured other factors such as under-reporting of use, reliance on only live birth data

Preterm Delivery & Fetal Growth

Preterm Delivery & Fetal Growth

OPPS Canadian Prospective Cohort Study

- No reduction in birth weight
- Shortened gestational age at delivery

MHPCD Pittsburgh Prospective Cohort Study

- Decrease in birth length with 1st/2nd trimester use
- Increase in birth weight with 3rd trimester use
- No effect on gestational age at delivery

Fried PA, et al. *American Journal of Obstetrics and Gynecology*. 1984;150(1):23-7.
Day N et al. *Neurotoxicology and Teratology.* 1991;13(3):329-34.

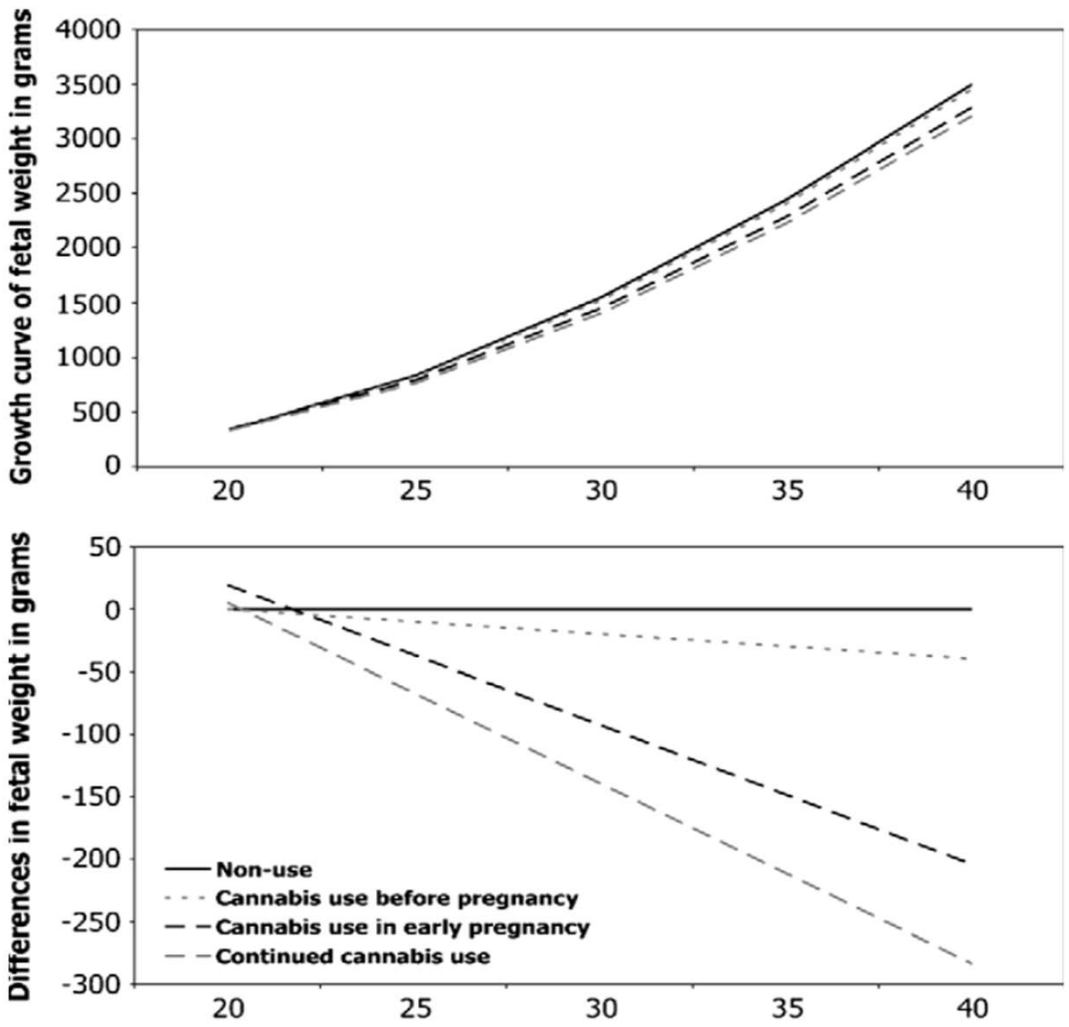
Preterm Delivery & Fetal Growth

Yale New Haven Hospital Study

- Regular (but not occasional) use in white women associated with increased risk of
  - low birth weight (odds ratio 2.6)
  - small for gestational age infant (odds ratio 2.3)
  - preterm delivery (odds ratio 1.9)
- No excess risks in non-white women

Hatch EE and Bracken MB. *American Journal of Epidemiology.* 1986;124(6):986-93.

Fetal Growth



El Marroun H et al *J Am Acad Child Adolesc Psychiatry* 2009

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Preterm Delivery & Fetal Growth

Brisbane Prospective Cohort Study

- Higher risk of low birth weight, and small infant size
- Increased risk for preterm delivery
- Findings took into account differences in maternal age, ethnicity, parity, body weight, alcohol, tobacco and other drug use

Hayatbakhsh MR et al. *Pediatric Research*. 2012;71:215-219.

Preterm Delivery & Fetal Growth

Table 3. Adjusted association of cannabis use during pregnancy with birth outcome, Mater Mothers' Hospital, 2000–2006

	Cannabis use during pregnancy		
	Unadjusted	Adjusted[a]	Adjusted[b]
Birth outcome	OR (95% CI)[c]	OR (95% CI)[c]	OR (95% CI)[c]
Birth weight			
<2,500 g	2.4 (2.0–2.9)**	2.3 (1.9–2.9)**	1.7 (1.3–2.2)**
2,500–4,000 g	Ref	Ref	Ref
>4,000 g	0.3 (0.2, 0.5)**	0.3 (0.2–0.5)**	0.5 (0.3–0.8)*
Preterm birth			
No	Ref	Ref	Ref
Yes	1.7 (1.4–2.1)**	1.7 (1.3–2.1)**	1.5 (1.1–1.9)*
SGA			
No	Ref	Ref	Ref
Yes	3.1 (2.5–3.7)**	3.1 (2.5–3.7)**	2.2 (1.8–2.7)**
NICU admission			
No	Ref	Ref	Ref
Yes	2.3 (1.9–2.7)**	2.3 (1.9–2.8)**	2.0 (1.7–2.4)**

Different from reference category at *P value < 0.01, **P value < 0.001.

CI, confidence interval; NICU, neonatal intensive care unit; OR, odds ratio; Ref, reference category; SGA, small for gestational age.

[a]Adjusted for mother's age, parity, ethnicity, and weight. [b]Adjusted for mother's age, parity, ethnicity, weight, cigarette smoking, alcohol consumption, and use of other illicit drugs during pregnancy. [c]No use of cannabis considered reference category.

Hayatbakhsh MR et al. *Pediatric Research*. 2012;71:215-219

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Preterm Delivery & Fetal Growth

SCOPE Consortium

- Increased risk of preterm delivery with continued use beyond 20 weeks' gestation (odds ratio 5.44) based on small number of exposed
- No increase in reduced birth size
- Findings took into account differences in maternal age, tobacco use, alcohol and socioeconomic status, ethnicity

Hayatbakhsh MR et al. *Pediatric Research*. 2012;71:215-219.

Preterm Delivery & Fetal Growth

National Birth Defects Prevention Case Control Study

- Mothers of 5,871 non-malformed infants interviewed after birth
- No increased risk, after accounting for other factors, for
  - reduced birth size
  - preterm delivery

Leemaqz SY et al. *Reproductive Toxicology*. 2016;62:77-86.

Summary: Preterm Delivery & Fetal Growth

- Study findings not consistent, but several studies show increased risks for reduced birth size or preterm delivery
- Most studies with positive findings show modest increased risks (odd ratios ~2)
- Possible conflicting findings are due to unmeasured (or poorly measured) other factors

Neurodevelopmental Effects

Neurocognitive and Behavioural Effects

18 months	3–6 years	9–10 years	14–16 years	17-22 years
Increased aggressive behaviour[c] Attention deficits (females)[c]	Deficits in: • Verbal and perceptual skills[ab] • Verbal reasoning[ab] • Visual reasoning[ab] • Verbal and quantitative reasoning[b] • Short-term memory[ab] Hyperactivity[ab] Attention deficits[ab] Impulsivity[ab] Impaired vigilance[b]	Deficits in: • Abstract and visual reasoning[ab] • Executive functioning[ab] • Reading[ab] • Spelling[ab] Hyperactivity[ab] Attention deficits[b] Impulsivity[b] Depressive and anxious symptoms[b]	Deficits in: • Visual-cognitive functioning[a] • Academic achievement[b] • Information processing speed[b] • Visual motor coordination[b] Delinquency[b]	Deficits in: • Executive functioning[a] • Response inhibition[a] • Visuospatial working memory[a] Smoking[ab] Substance use[ab] Early initiation of substance use[ab]

[a]OPPS [b]MHPCD [c]Generation R

Fried PA and Makin JE. *Neurotoxicology and Teratology.* 1987;9(1):1-7.
Fried PA et al. *Neurotoxicology and Teratology*. 1998;20(3):293-306.
Fried PA et al, *Neurotoxicology and Teratology*. 2003;25(4):427-36.
Smth AM et al. Ne*urotoxicology and Teratology.* 2016;26(4):532-42.
Day NL et al. *Neurotoxicology and Teratology.* 1994;16(2):169-75.
Goldschmidt L et al. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2008;47(3)254-63.
Leech SL et al. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2006;45(2):223-30.
El Marroun H et al. *Drug and Alcohol Dependence.* 2011;118(2-3)470-4.

Neurodevelopmental Effects

Generation R study of brain structure

- Children evaluated at 6-8 years of age with Magnetic Resonance Imaging (MRI)
- Compared groups with prenatal exposure to:
  - Cannabis (plus tobacco)
  - Tobacco alone
  - Neither
- Found no difference in global brain volumes

El Marroun H et al. *Biological Psychiatry.* 2016;79(12):971-9.

Neurodevelopmental Effects

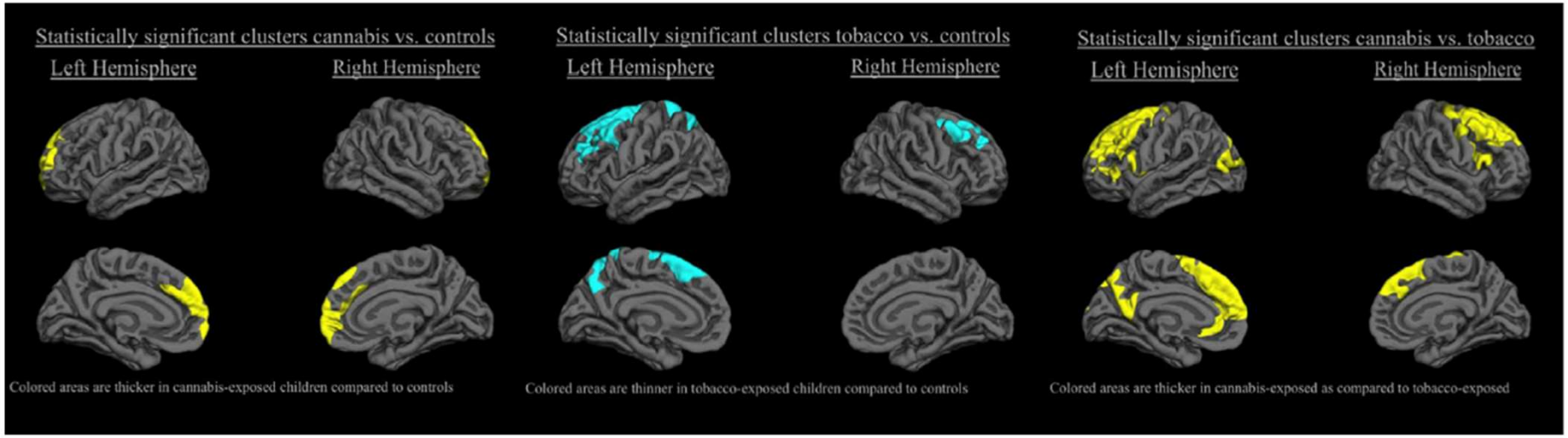

Figure 1. Vertex-wise analysis: The association between prenatal cannabis and/or tobacco exposure and cortical thickness.

Children born to cannabis users had thicker frontal cortical areas of the brain (highlighted in yellow) compared to

- Children born to mothers who used tobacco only
- Children born to mothers who used neither

El Marroun H et al. *Biological Psychiatry.* 2016;79(12):971-9.

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Neurodevelopmental Effects

- Unclear whether the differences found at this one time point:
  - relate to performance in the child
  - are due to prenatal exposure to cannabis

- But raises the question, as changes in the thickness of specific sections of the brain take place over prenatal life through adulthood

- Global intelligence scores are typically not affected, but cognition involved with executive functioning (e.g. attention, inhibitory control, planning) can be negatively impacted

El Marroun H et al. *Biological Psychiatry.* 2016;79(12):971-9.
Grant KS et al. *Pharmacol Ther.* 2018; 182: 133-151

Neurodevelopmental Effects

- Subsequent analysis of data from same cohort using maternal and teacher report forms at 7-10 years of age
  - Found associations with prenatal exposure and externalizing behaviors but not internalizing
  - However, associations also found with pre-conception exposure and paternal exposure

- Additional analysis of psychotic-like experiences in children resulted in similar findings
  - 1.4 fold increased risk with prenatal cannabis use, but similar with preconception or paternal exposure only

- Authors concluded deficits unlikely to be due to prenatal exposure but more likely explained by shared genetic vulnerabilities

El Marroun H et *al.Intl J Epidemiol* 2018
Bolhuis K et al, *Schozophren Res* 2018

Summary: Neurodevelopmental Effects

- Consistent data from the available prospective cohort studies that there may be neurodevelopmental effects of prenatal exposure to cannabis
- However, the data are still limited, sample sizes have been relatively small, and there are even smaller numbers of children with long-term follow-up
- To what extent are some findings due to heredity, and/or other environmental factors?

Marijuana Use in Pregnancy: What Next?

- Number of studies available limited & individual sample sizes of exposed women still small

- Only 1 study reviewed had a single-time point biomarker of maternal cannabis use
  - Better measures of the true dose of the drug and gestational timing of use in pregnancy needed

- Better data on co-exposures to other substances i.e, alcohol and tobacco needed

- Newer studies needed, given the increase in potency of cannabis products

Marijuana Use in Lactation

- Limited data on quantity of cannabis metabolites that cross into breast milk
- 3 case reports in the literature document measurable levels of THC in mother's milk, but no follow-up for the infants being breastfed
- 1 of the 3 case reports suggested breast milk levels were much higher than maternal blood levels of THC

Perez-Reyes M and Wall ME. *The New England Journal of Medicine.* 1982;307:819-820.
Marchei E, et al. *Journal of Pharmaceutical and Biomedical Analysis.* 2011; 55:309-316

Marijuana in Lactation and Infant Development

- One small study showed no evidence of motor or mental developmental deficits in 27 one-year-old infants whose mothers used marijuana while breastfeeding compared to 35 unexposed infants

- A second small study examined motor and mental performance in 55 one-year-old infants breastfed by a mother using cannabis compared to 81 unexposed infants

- Cannabis use in first month post-partum was associated with decreased motor performance in the infants at one year of age

- However, authors could not entirely separate potential effects from prenatal exposure vs. breastfeeding

Tennes K, et al. *NIDA Research Monograph.* 1985; 59:48-60.
Astley SJ and Little RE. *Neurotoxicology and Teratology*. 1990;12:161-168.

Marijuana Use in Lactation

- A recent study detected low concentrations of delta-9-tetrahydrocannabinol in breastmilk

Parameter (Units)	Calculated Value*	Median (Range)
AUC (ng/h/mL)	213.9	110.5 (33.9–744.4)
C_{avg} (ng/mL)	53.5	27.6 (8.4–186.1)
C_{max} (ng/mL)	94	44.7 (12.2–420.3)
T_{max} (h)	1	1 (1–2)
Infant dose (micrograms/kg/d)	8	4.1 (1.3–27.9)
RID (%)	2.5	1.3 (0.4–8.7)

AUC, area under the drug concentration time curve; C_{avg}, average drug concentration across the dose interval; C_{max}, maximum drug concentration across the dose interval; T_{max}, time at which maximum concentration is observed; RID, relative infant dose for delta-9-tetrahydrocannabinol in milk.

* Calculated value is obtained from the combined data at each time point for each parameter.

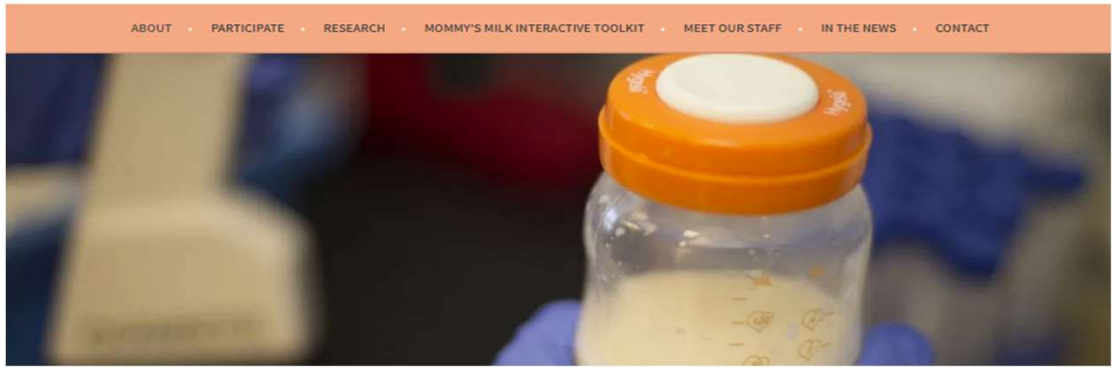
Baker T. et al. *Obstetrics & Gynecology*. 2018; 131:783-788

Mommy's Milk Human Milk Research Biorepository (HMB)

Initiatives include two main efforts:

- Establish a clinical research database of human milk samples for scientists to use to address multiple research questions
- Further the understanding of the relationship between human breast milk and infant and child health and development

Mommy's Milk
HUMAN MILK RESEARCH BIOREPOSITORY



Study Design, Recruitment and Data

Study Design

- 50 mL milk sample up to full pump: local collection or mailed
- Samples stored in a -80◦ C freezer at UCSD

Recruitment Sources

- MotherToBaby Pregnancy Studies (US & Canada)
- Social media
- Local newborn nurseries
- San Diego Blood Bank/San Diego Milk Bank

Data

- Demographics, maternal and child health, and breastfeeding habits
- Exposures to recreational drugs, alcohol, tobacco, caffeine, prescription medications, and over-the-counter medications over past 14 days
- Infant adverse reaction checklist
- Stress, anxiety, depression, food frequency questionnaires (on-line)
- Neurobehavioral questionnaires 12-36 months; face-to-face testing for subset
- Access to medical records

Cannabinoid Analysis - HMB

Objectives

- To determine if cannabinoids are measurable in human milk following maternal marijuana use
- To investigate the relationship between cannabinoid concentrations, the reported dose, and time post-marijuana use in breastfeeding women

Design

- 54 human milk samples with known maternal marijuana exposure were analyzed at the UCSD Skaggs School of Pharmacy
  - 50 unique women; 4 women provided 2 samples at different time points
- Examined THC, 11-OH-THC, CBD, and CBN simultaneously using saponification to extract the cannabinoids and LC-MS to quantify

Bertrand K et al. *Pediatrics* 2018

Cannabinoid Analysis

Select Demographic & Maternal Characteristics of Breastfeeding Women with Marijuana Exposure in the HMB, 2014-2016

Characteristic	N= 50 mothers, No. (%)
Maternal Age (yrs)	
≤25	7 (14)
25-30	17 (34)
30-35	18 (36)
≥35	8 (16)
Maternal Ethnicity	
Hispanic	9 (18)
Non-Hispanic	41 (82)
Maternal Race	
Caucasian	44 (88)
Black	1 (2)
Asian	2 (4)
Native American	3 (6)
Maternal Education (yrs)	
Partial High School	1 (2)
High School Graduate/GED	4 (8)
Some College/ Specialization	27 (54)
College Graduate	14 (28)
Post-Graduate	4 (8)
Maternal Body Mass Index (BMI)[a]	
<18.5	0 (0)
18.5-24.99	17 (34)
25-29.99	17 (34)
>30	9 (18)

Select Child Characteristics

Characteristic	N= 50 mothers, No. (%)	N=4 mothers who gave a repeat sample, No. (%)
Infant Age (months)[d]		
0-3	3 (6)	0 (0)
3-6	20 (40)	0 (0)
6-12	11 (22)	0 (0)
>12	16 (32)	4 (100)
Infant Sex		
Female	22 (44)	
Male	28 (56)	

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Cannabinoid Analysis

Methods and Frequency of Marijuana Use in Breastfeeding Women

Characteristic	N= 50 mothers, No. (%)	N=4 mothers who gave a repeat sample, No. (%)
Route of Marijuana Exposure[a]		
Inhalation Only	32 (64)	2 (50)
Other Only	7 (14)	0 (0)
Both	11 (22)	2 (50)
Frequency of Marijuana Use		
<1 use/day	6 (12)	1 (25)
1 use/day	23 (46)	3 (75)
>1 use/day	21 (42)	0 (0)

[b] Inhalation Only was defined as a dose unit of joints, puffs, or grams. Other Only was defined as a dose unit of drops, milligrams or servings. Both was defined as a dose unit from both the Inhalation Only and the Other Only groups

The most common route of administration was by inhalation only (64%). Most women in the sample (88%) reported daily marijuana with one or more uses each day

Bertrand K et al. *Pediatrics* 2018

Cannabinoid Analysis

THC, 11-OH-THC, and CBD Levels Detected in Breast Milk

	Min.	1st Qu.	Median	3rd Qu.	Max.	AQL*	BQL*
Δ9-THC (ng/mL)	1.01	2.29	9.47	46.78	323.00	34	20
11-OH-THC (ng/mL)	1.33	1.35	2.38	5.45	12.80	5	49
CBD (ng/mL)	1.32	2.92	4.99	5.97	8.56	5	49

*AQL (above quantification limits) was defined as ≥1ng/ mL and BQL (below quantification limits) was defined as <1 ng/mL
** The concentration of CBN was BQL in all 54 samples

Δ9-THC was detectable in 34 of 54 samples (63%); among these, the median concentration of Δ9-THC was 9.47 ng/mL of breast milk (range: 1.01, 323.00)

Bertrand K et al. *Pediatrics* 2018

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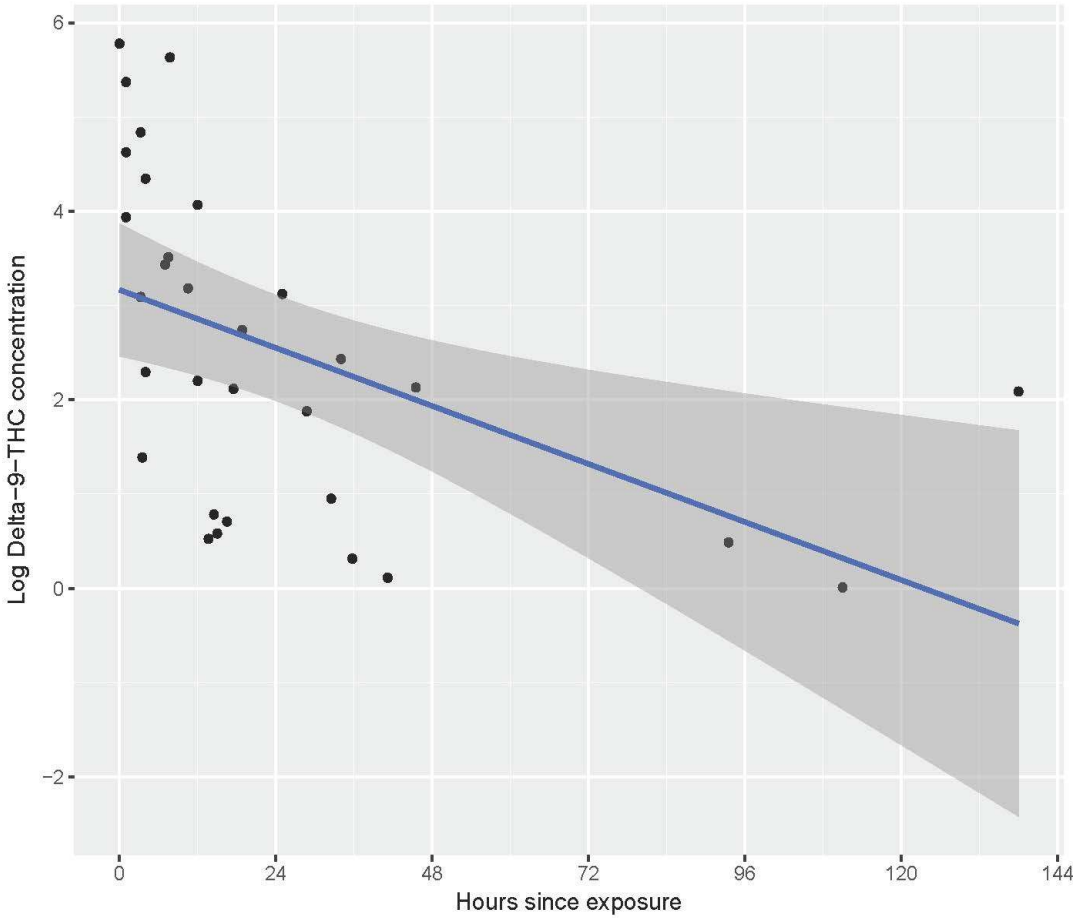
Cannabinoid Analysis

	Estimate	Std. Error	95% CI	t value	p-value
Uses per Day					
(Intercept)	2.21	0.55	(1.08, 3.33)	4.02	<.001
Hours[a]	-0.02	0.01	(-0.037, -0.0002)	-2.25	0.032
Uses/Day[b]	0.51	0.23	(0.03, 0.99)	2.17	0.039
Route[c]					
(Intercept)	3.37	0.37	(2.62, 4.12)	9.21	<.001
Hours	-0.02	0.01	(-0.04, -0.01)	-2.85	0.008
Route: Other Only	-0.69	1.15	(-3.06, 1.67)	-0.60	0.553
Route: Both	-1.11	0.74	(-2.64, 0.41)	-1.50	0.146
Puffs[d]					
(Intercept)	3.29	0.68	(1.87, 4.70)	4.81	<.001
Hours	-0.02	0.01	(-0.04, -0.00)	-2.31	0.031
Puffs	-0.04	0.15	(-0.34, 0.26)	-0.28	0.785
Heavy Use[e]					
(Intercept)	2.72	0.44	(1.80, 3.64)	6.14	<.001
Hours	-0.02	0.01	(-0.04, 0.00)	-1.97	0.062
Heavy Use	1.13	0.68	(-0.28, 2.53)	1.66	0.110

There is a reduction in milk Δ9-THC concentration of 2.6% per hour after exposure, which can be used to estimate a half-life of approximately 27 hours for Δ9-THC in human milk

Cannabinoid Analysis

Scatterplot and Fitted Regression
Last Use of Marijuana, N=34



	Estimate	Std. Error	95% CI	t value	p−value
(Intercept)	3.166	0.344	(2.463, 3.869)	9.208	< .001
Hours	−0.026	0.008	(−0.043, −0.008)	−3.025	0.005

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Marijuana Use in Lactation and Infant Developmental Outcomes HMB

Future Research

- Examine the relationship between concentrations of cannabinoids and infant/toddler neurobehavioral outcomes using validated maternal report questionnaires and face-to-face testing

Summary

- Very limited data on cannabis use and breastfeeding
- Older and current data suggest that THC is measurable in breastmilk in small quantities, and may persist for several days
- However, limited data on neurodevelopmental impact
- More work to be done

Summary

The American College of Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

American Academy of Pediatrics

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- ACOG-women who are pregnant or contemplating pregnancy should be encouraged to discontinue marijuana use
- ACOG-insufficient data to evaluate the effects of marijuana use on infants during lactation and breastfeeding, and in the absence of such data, marijuana use is discouraged
- AAP recommends women of childbearing age to abstain from marijuana use while pregnant or breastfeeding due to potential adverse consequences to the fetus, infant or child
- FDA and Surgeon General advise avoiding marijuana during pregnancy and lactation

Thank you

- https://betterbeginnings.org/
- https://mommysmilkresearch.org/
- https://mothertobaby.org/
- chchambers@ucsd.edu