Impact of Moderate Fetal Alcohol Exposure on Child Development

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Fetal Alcohol Exposure and Infant Cognition

Fetal Alcohol Exposure and School Age Cognitive Function

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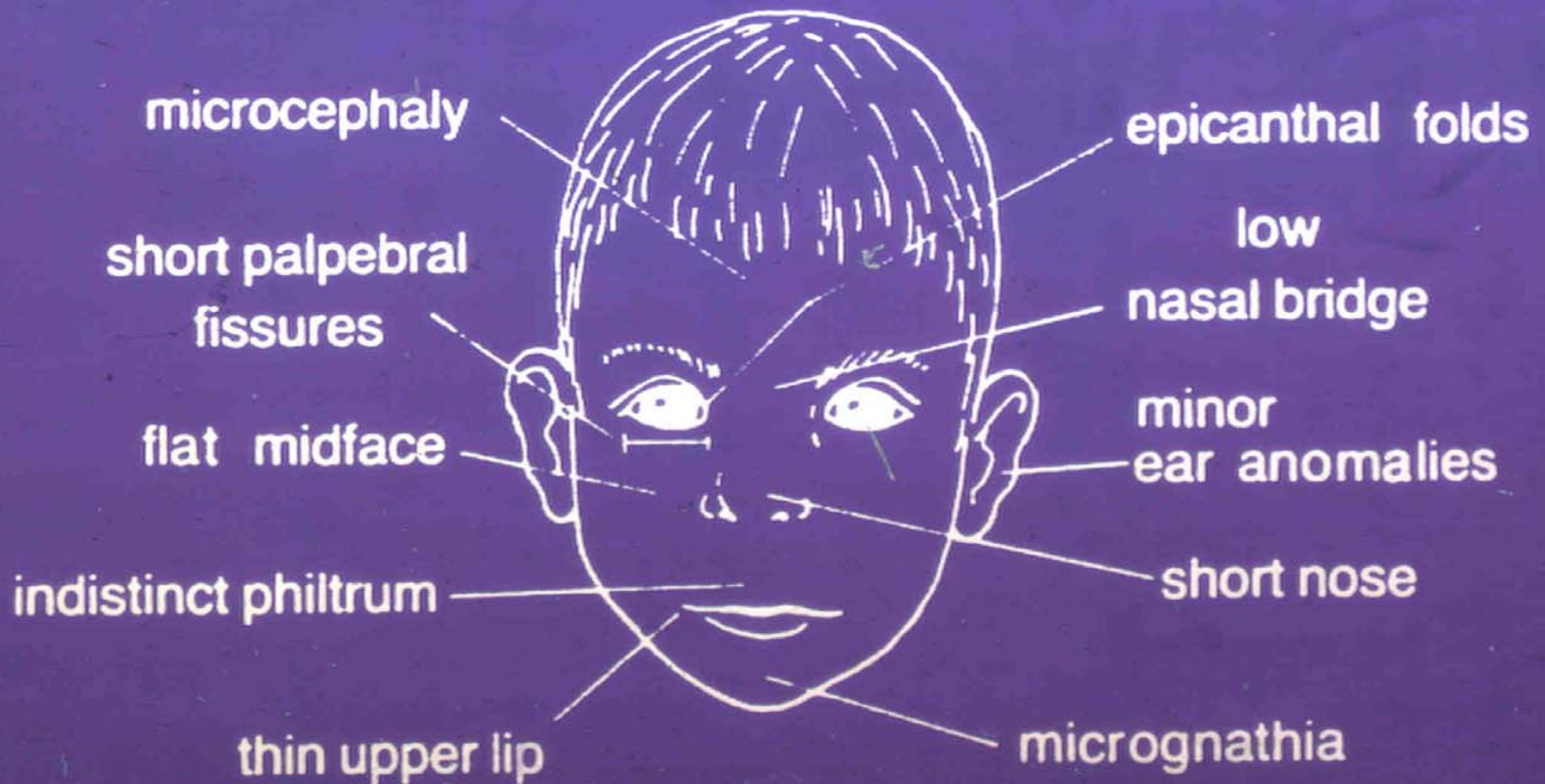*Sample:* 480 black, inner-city Detroit infants and their mothers

Funding: National Institute on Alcohol Abuse and Alcoholism

FETAL ALCOHOL SYNDROME DIAGNOSIS

* Characteristic pattern of facial anomalies (including short palpebral fissures, flat upper lip, flattened philtrum, and flat midface)

* Growth retardation

* Central nervous system neurodevelopmental abnormalities

Source: National Academy of Sciences Institute of Medicine Report (1996)

FACIES IN FETAL ALCOHOL SYNDROME

microcephaly

short palpebral fissures

flat midface

indistinct philtrum

thin upper lip

epicanthal folds

low nasal bridge

minor ear anomalies

short nose

micrognathia

Figure 1 Similarities of facial defects found in (A) humans and (B) mice exposed prenatally to alcohol. Panel C shows a control mouse fetus not exposed to alcohol. Photograph courtesy of Kathy K. Sulik.

Labels in panel A/B:
- Narrow forehead
- Short palpebral fissures
- Small nose
- Small midface
- Long upper lip with deficient (flat) philtrum

Alcohol-related Neurodevelopmental Disorder (ARND)

* Found in children born to women who are *not* alcohol-dependent but drink recreationally during pregnancy

* No distinctive facial dysmorphology

* Principal characteristics are intellectual and behavioral problems

Heavy exposure defined as 1 oz AA/day

$$\cong$$

2 standard drinks

Moderate exposure defined as .5 AA/day

$$\cong$$

1 standard drink

Sample

- Data were collected as part of the Detroit Prenatal Alcohol Exposure and Infant and Child Development.

- Prenatal alcohol exposure based on 2-week day-by-day drinking histories obtained at each prenatal visit.

- Recall linked to specific times and activities.

- The number of prenatal visits ranged from 1 - 14 with a median of 5 visits.

Maternal Alcohol Consumption
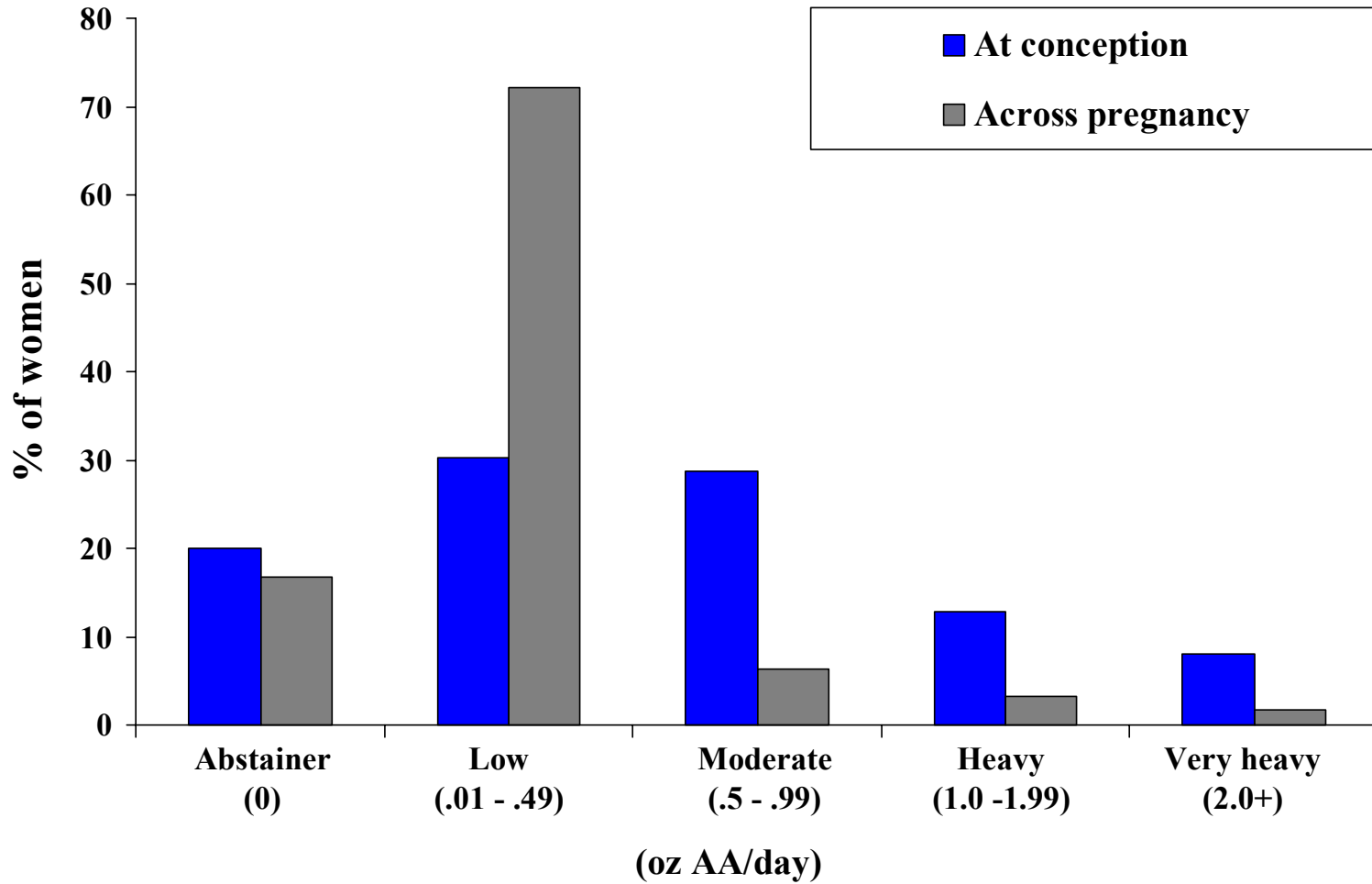
Number of Women Drinking at Least Once per Week
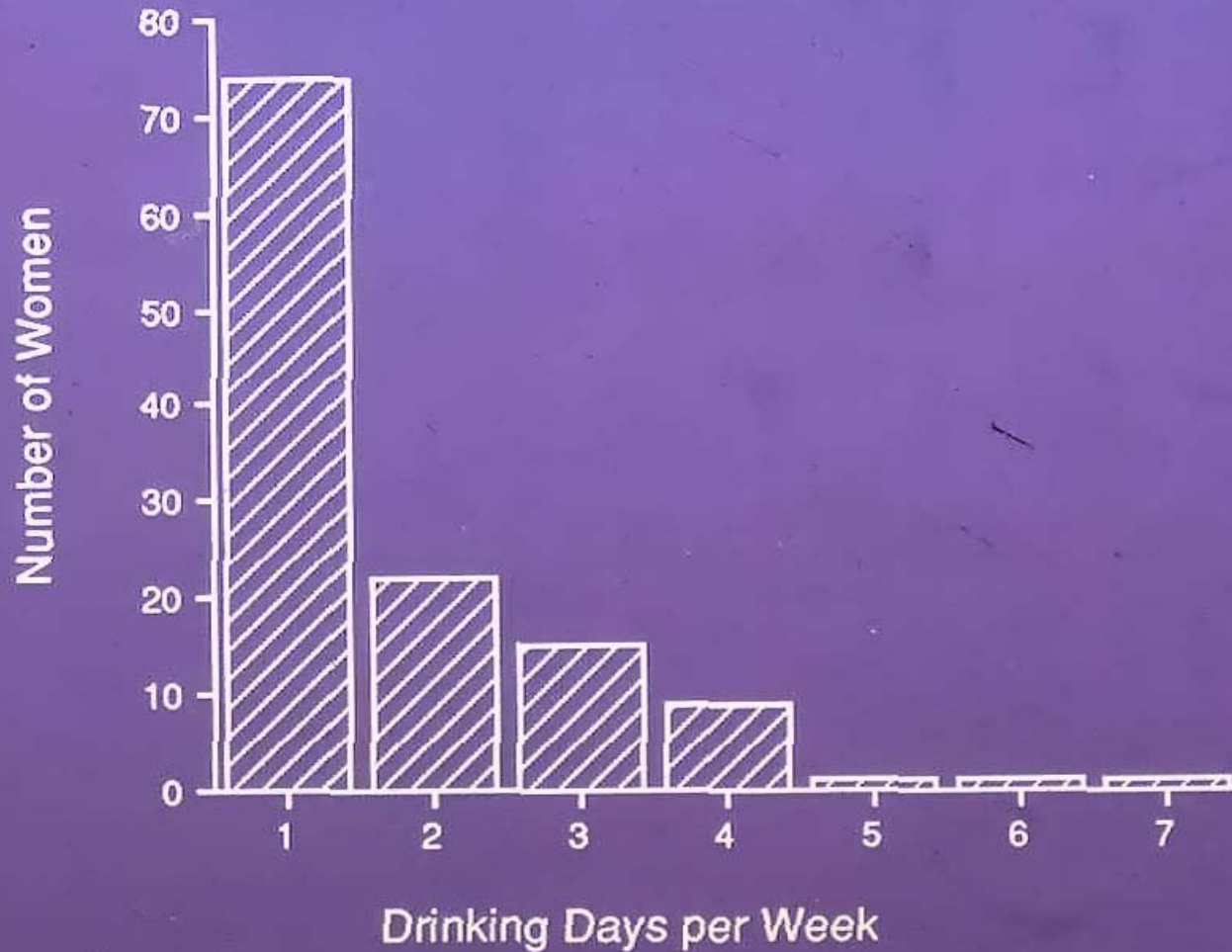
	Smoking and Drug Use (N = 480)		
	M or %	SD	Range
Cigarettes (num/day)	9.0	11.1	0.0 - 60.0
Cocaine use			
Frequency (days/month)	1.2	2.7	0.0 - 20.0
% Used (yes/no)	31.4%	—	—
% Heavy use ($\geq$2 days/week)	17.9%	—	—
Marijuana use (days/month)	0.9	2.3	0.0 - 19.2

Maternal Demographics

	N	Mean or %	SD	Range
Education (yr)	480	11.7	1.6	6 - 18
Welfare (%)	480	83.5	--	--
Marital status (% married)	480	10.0	--	--
Age at conception	480	26.4	6.0	14 - 44
Parity	480	2.4	1.5	1 - 11
Prenatal visits	480	5.3	3.2	1 - 14
Beck Depression	464	11.2	7.6	0 - 38
Peabody Picture Vocabulary Test	443	72.3	12.8	40 - 110

Infant/Child Assessments

- 6.5-months

- 12-months

- 13-months

- 7.5-years

- 13.5-years

Control Variables – 7.5-Year Follow-up

Demographic Background

    Socioeconomic Status

    Maternal Age

    Marital Status

    Parity

    Number of Children in Household

    Crowded

Prenatal Variables (Maternal)

    Cocaine

    Marijuana

    Smoking

Postnatal Variables (Caregiver)

    Alcohol

    Cocaine

    Marijuana

    Smoking

Social Environment (Caregiver)

    Education

    Verbal IQ (PPVT-R)

    HOME Inventory

    Familial Stress

    Beck Depression Inventory

    Conflict Tactics

    Social Support

Child Variables

    Gender

    Age at Testing

    Grade in School

Child Examiner

Main Effects Found in Infant Assessment

Prenatal alcohol exposure was related to slower information processing on 3 tests at 6.5 and 12 months:

1. Fagan Test of Infant Intelligence (FTII)

2. Cross Modal Transfer

3. Haith's Visual Expectancy Paradigm (VExP)

Alcohol also related to:

      1. Poorer complexity of play on Belsky scale

      2. Poorer Bayley MDI scores

Relation of Maternal Alcohol and Growth

	N	r
Birth		
Weight	470	-.22***
Length	461	-.19***
Head circumference	459	-.10***
6.5 months		
Weight	433	-.17***
Length	432	-.12***
Head circumference	431	-.10*
12 months		
Weight	358	-.07
Length	359	-.14**
Head circumference	358	-.04

Note: Excluding GA < 35 weeks.
*p < .05. **p < .01. ***p < .001.

Relation of Maternal Drinking to 7.5-Year WISC-III IQ Scores

	Alcohol during Pregnancy	
	r	β
Full Scale IQ	-.05	-.01
Verbal IQ	-.05	-.02
Performance IQ	-.05	-.02
Freedom from Distractibility	-.17***	-.16**
Arithmetic	-.12*	-.13*
Digit Span	-.18***	-.16**

*p < 0.01. **p < 0.05. ***p < .001.

MIRSKY'S ELEMENTS OF ATTENTION

Sustained attention ("sustain")   Ability to maintain focus and alertness over time

Selective Attention ("focus")   Ability to maintain attention in the presence of distraction

Executive function ("shift")   Ability to coordinate, plan, execute appropriate responses and modify behavior in response to feedback

Working memory ("encode")   Sequential mental manipulation of information linking input from the environment with information retrieved from memory

Mirsky Attention Battery

	Drinking during pregnancy	
	r	β
Focus		
WISC-III Coding	-.05	-.03
Digit Cancellation	.10*	.10†
Digit Cancellation w/interference	.16**	.15**
Working memory (encode)		
WISC-III Arithmetic	-.12*	-.13*
WISC-III Digit Span	-.18***	-.13*
Seashore Rhythm	-.12*	-.09
Executive function (shift)		
Wisconsin Card Sorting Test		
Categories completed	-.10	-.01
Perseverative errors	.23**	.24*
Tower of London	-.17***	-.15**
Verbal Fluency	-.15**	-.13*

†$p < 0.10$. *$p < 0.05$. **$p < 0.01$. ***$p < .001$.

Teacher Report

	Drinking during pregnancy	
	r	β
DuPaul Barkley		
ADHD	.23***	.20**
Impulsivity	.22***	.19**
Inattention	.23***	.14*
Achenbach Teacher Report Form (TRF)		
Attention	.22***	.15*
Aggressive	.19***	.18**
Delinquent	.19***	.14*
Social	.19***	.17**
Externalizing	.20***	.18**
Internalizing	.02	.00
Total	.11*	.09

*p<.05, **p<.01, ***p<.001.

Items Most Strongly Related to Alcohol

- Aggression items
  - "gets into many fights"
  - "argues a lot"
  - "teases a lot"
  - "destroys property belonging to others"
- Social items
  - "being teased"
  - "feeling others were out to get him/her"
  - "inability to get along with other peers"
- Other items
  - "poorly coordinated"
  - "clumsy"
  - "accident prone"

Relation between Prenatal Alcohol Exposure and Dysmorphology

Variables	Alcohol at Conception	Estimated Alcohol during Pregnancy		
		1st	2nd	3rd
N	298	298	298	298
Dysmorphology [a]	**.15**[**]	**.17**[**]	.08	.09

[**] $p < .01$.

[a] Based on 4 key features related to FAS: flat midface, short palpebral fissures, flat philtrum, thin upper lip.

Relation between Prenatal Alcohol Exposure and Growth

	Alcohol at Conception	Estimated Alcohol during Pregnancy		
		1st	2nd	3rd
Birth				
N	479	479	479	479
Weight	**-.14****	**-.18*****	**-.19*****	**-.19*****
Length	**-.14****	**-.16*****	**-.15*****	**-.15*****
Head circ.	**-.11***	**-.15*****	**-.19*****	**.18*****
6.5 months				
N	441	441	441	441
Weight	-.06	**-.12****	**-.15****	**-.11***
Length	-.05	-.08	**-.10***	**-.10***
Head circ.	-.01	-.07	-.09†	**-.13****

†p<.10. *p<.05. **p<.01. ***p<.001.

Relation between Prenatal Alcohol Exposure and Infant Cognitive Outcomes

Variables	Alcohol at Conception	Estimated Alcohol during Pregnancy		
		1st	2nd	3rd
Fixation duration				
N	361	361	361	361
Fagan (FTII)[a]	.11†	**.12***	**.14****	.11†
Cross modal	.10†	**.11***	**.15****	**.17*****
Play				
N	309	309	309	309
Spontaneous play	**-.13***	-.11†	-.11†	**-.11***
Elicited play	**-.15****	**-.17****	-.10†	**-.14****
Mean SDA[b]	**.13***	**.15****	.09	.09
Bayley				
N	382	382	382	382
Mental	**-.11***	**-.16****	**-.14****	**-.15****
Psychomotor	**-.12***	**-.15****	**-.13***	-.02

†$p<.10$. *$p<.05$. **$p<.01$. ***$p<.001$.

[a] Average of 6.5 and 12 months visits. [b] Mean of two longest periods of sustained directed activity.

Relation between Prenatal Alcohol Exposure and 7.5-Year Outcomes

Variables	Alcohol at Conception	Estimated Alcohol during Pregnancy		
		1st	2nd	3rd
<u>N</u>	335	335	335	335
WISC III				
Freedom from Distractibility	**-.16****	**-.15****	**-.12***	**-.14***
Digit Span	**-.19*****	**-.17****	**-.14****	**-.14****
Seashore Rhythm	**-.14****	**-.13***	**-.11***	-.07
Verbal Fluency	**-.12***	**-.13***	.09	**-.14***
Sternberg				
# correct no	**-.16****	**-.15****	-.10†	-.01
Digit Cancellation	.11†	.09	**.17****	**.18*****
<u>N</u>	67	67	67	67
Wisconsin Card Sorting Test	**.29***	**.30***	**.28***	.21†

†p<.10. *p<.05. **p<.01. ***p<.001.

Relation between Prenatal Alcohol Exposure and TRF

Variables	Alcohol at Conception	Estimated Alcohol during Pregnancy		
		1st	2nd	3rd
<u>N</u>	249	249	249	249
Social problems	**.13**[*]	.11[†]	**.14**[*]	**.18**^{**}
Thought problems	.08	.07	.07	**.15**[*]
Attention problems	**.17**^{**}	**.17**^{**}	**.17**^{**}	**.20**^{***}
Delinquency	**.14**^{**}	.11[†]	**.12**[*]	**.17**^{**}
Aggression	**.12**[*]	.11[†]	**.14**[*]	**.17**^{**}
Externalizing	**.13**[*]	.11[†]	**.15**[*]	**.18**^{**}
Total	.05	.07	.08	**.17**^{**}

†$p<.10.$ *$p<.05.$ **$p<.01.$ ***$p<.001.$

Implications

- Trimester-specific effects suggest different underlying mechanisms.

- Prevention issues need to be considered. When is it too late?