Associations between prenatal alcohol exposure, behavior, diet, and obesity

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3 primary studies

- BMI in 445 people with FASD vs. controls (ages 2-19)
- Diet in 31 children with FASD (ages 2-5)
- Eating behavior in youth with FASD and controls

NOTE: Studies of youth are relevant because there is a developmental impact on adult behavior and health.
Child and Adolescent Obesity

1 in 3 children are overweight or obese by their 5th birthday.
Growth deficiency defining feature of FAS

FASD spectrum: Variation in growth

Very little is known about long-term growth in FASD

Are those with FASD at risk for overweight or obesity?
FASD studies:
Weight increases over time (Klug et al., 2003; Spohr et al., 2007)

Individuals with general behavior regulation difficulties:
(e.g., ADHD) have a greater risk for obesity (Lumeng et al., 2012; Byrd et al., 2013)

Impulsivity & Impaired Behavior Regulation
• Proposed role in ADHD obesity (Byrd et al., 2013)
• Role in obesity risk in general (Nederkoorn et al., 2006)
• ADHD is a well-recognized problem in FASD (e.g., Mattson et al., 2001)
Prenatal alcohol and metabolic disturbance

- Impaired glucose homeostasis
- Insulin resistance
- “Catch-up” syndrome (metabolic effect)

Chen & Nyomba (2003); Dobson et al (2012); Bertram & Hanson (2001)
Study 1: BMI in FASD

- Patients clinically evaluated for FASD in Minnesota
- Ages: 2-19 years
- FASD diagnosis: n = 446
- No FASD diagnosis: n = 171

Weight Categories:
- **Overweight & obese**: BMI ≥ 85th percentile
- **Underweight**: BMI < 5th percentile

(advantages over traditional control group)
Overweight and Obesity Among Children and Adolescents with Fetal Alcohol Spectrum Disorders

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Background: Because prenatal alcohol exposure is associated with growth deficiency, little attention has been paid to the potential for overweight and obesity in children with fetal alcohol spectrum disorders (FASD). This study examined the prevalence of overweight/obesity (body mass index [BMI]) in a large clinical sample of children with FASD.

Methods: Children, aged 2 to 19 years, who were evaluated for FASD at University Clinics, included 445 with an FASD diagnosis and 171 with No-FASD diagnosis. Prevalence of overweight/obesity (BMI ≥85 percentile) was compared to national and state prevalence. BMI was examined in relation to FASD diagnosis, gender, and age. Dietary intake data were examined for a young subsample (n = 42).

Results: Thirty-four percent with any FASD diagnosis were overweight or obese, which did not differ from the No-FASD group or U.S. prevalence. Underweight was prevalent in those with fetal alcohol syndrome (FAS) (17%). However, increased rates of overweight/obesity were seen in those with partial FAS (40%). Among adolescents, those with any FASD diagnosis had increased overweight/obesity (42%), particularly among females (50%). The rate in adolescent females with FASD (50%) was nearly 3 times higher than state prevalence for adolescent females (17 to 18%), p < 0.001. In the young subsample, those who were overweight/obese consumed more calories, protein, and total fat per day than those who were not overweight or obese.

Conclusions: Rates of overweight/obesity are increased in children with partial FAS. In adolescents, rates are increased for any FASD diagnosis (particularly in females). Results are suggestive of possible metabolic/endocrine disruption in FASD—a hypothesis for which there is evidence from animal models. These data suggest that clinicians may consider prenatal alcohol exposure as a risk factor for metabolic/endocrine disruption, should evaluate diet as a risk in this population, and may need to target interventions to females prior to puberty to effect changes in overweight-related outcomes.

Key Words: Body Mass Index, Nutrition, Obesity, Fetal Alcohol Spectrum Disorders.
BMI compared to US Data

- Underweight
- Overweight or Obese
- FAS
- Partial FAS
- ARND
- No FASD Diagnosis

US Data
BMI compared to US Data

- Underweight
- Overweight or Obese

Categories:
- FAS
- Partial FAS
- ARND
- No FASD Diagnosis
- US Data
BMI compared to US Data

Underweight Overweight or Obese

- Underweight: FAS, Partial FAS, ARND, No FASD Diagnosis, US Data
- Overweight or Obese: FAS, Partial FAS, ARND, No FASD Diagnosis, US Data

* indicates significant difference
BMI compared to US Data

Underweight Overweight or Obese

- FAS
- Partial FAS
- ARND
- No FASD Diagnosis
- US Data
BMI compared to US Data

- Underweight
- Overweight or Obese

Legend:
- FAS
- Partial FAS
- ARND
- No FASD Diagnosis
- US Data
BMI compared to US Data
BMI compared to MN data

- FASD Diagnosis
- No FASD Diagnosis

Chart showing BMI compared to MN data for different age groups and genders.
BMI compared to MN data

<table>
<thead>
<tr>
<th>Age Group</th>
<th>FASD Diagnosis</th>
<th>No FASD Diagnosis</th>
<th>MN Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to less than 5 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 to 19 years: Males</td>
<td></td>
<td></td>
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<tr>
<td>13 to 19 years: Females</td>
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</tr>
</tbody>
</table>
BMI compared to MN data

2 to less than 5 years
13 to 19 years: Males
13 to 19 years: Females

FASD
No FASD Diagnosis
MN Data
BMI compared to MN data

- 2 to less than 5 years: Males
- 13 to 19 years: Males
- 13 to 19 years: Females

Comparison categories:
- FASD
- No FASD Diagnosis
- MN Data
Dietary Intake

- Subsample 2-5 years: n=42
- 24-hour dietary recalls
- Trend toward obesity in pFAS group
- Requires a different design...

![Graph showing dietary intake](image)
Impulsivity & Poor Behavior Regulation

Neuropsychological data

- CPT Commission Errors
  - Non-overweight: [Error Count]
  - Overweight: [Error Count]

- BRIEF Behavior Regulation Index
  - Non-overweight: [T score]
  - Overweight: [T score]

- IQ
  - Non-overweight: [IQ]
  - Overweight: [IQ]

- % kcal Fat vs. Effortful Control
  - Scatter plot showing the relationship between % kcal Fat and Effortful Control.
Overweight & obesity may be increased in FASD

Especially for:

- Adolescents
  - Males (37% vs. 27% for MN data)
  - Females (50% vs. 18% for MN data)
- Partial FAS, not FAS
- Linked to behavioral control?
3 primary studies

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Nutrition and brain development

Human Brain Development

- Experience-dependent synapse formation
- Neurogenesis in the Hippocampus
- Synaptogenesis (3 months to 15-18 years)
- Adult Levels of synapses

Thompson & Nelson, 2001
Animal models of FASD:
Supplementation with specific nutrients may improve cognitive outcomes

Choline
Vitamin D
Omega-3 fatty acids

Choline: Thomas et al., 2007; Vitamin D: Idrus et al., 2013; Omega-3: Patten et al., 2012
2 studies examining the role of nutrition as an intervention in FASD

- Choline affects gene expression, neurotransmitter synthesis, cell maintenance

- Ages: 2.5 to <5 years with FASD

- High feasibility and tolerability for choline supplementation for 9 months

- Modest improvement in memory for youngest children (2-3 year olds)

- Latest data (unpublished) suggests severely impacted may be more responsive
Improvement after 9 months

Elicited imitation memory performance: Baseline to 9 months

* $d = .54$

* $d = .50$
Dietary intake in children with FASD

- 31 children with an FASD diagnosis
- Age: 2.5 to <5 years
- 24-hour dietary recall; Three times over nine months
- No control group, so comparisons to RDA/AI
- Relevance? Supplementation and brain development
Inadequate intake of nutrients essential for neurodevelopment in children with fetal alcohol spectrum disorders (FASD)

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- FASD group was below RDA/AI (recommended / adequate intake)
  - Choline
  - N3 Fatty Acids
  - Vitamin D *
  - Vitamin E
  - Vitamin K
  - Vitamin K
  - Calcium *
  - Fiber

* also below NHANES means
Inadequate intake of nutrients essential for neurodevelopment in children with fetal alcohol spectrum disorders (FASD)

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>84% of participants had inadequate levels of dietary choline intake (ASA-24)
Children with FASD have diets insufficient in key nutrients for brain development

Reasons are not entirely clear
- Picky eating
- Preferences for high fat / high sugar food
- Hyperactivity / other behavior interfering with eating routines
- Physiological / metabolic / other (sensitivities, allergies, etc.)

Early nutrition is critical to lifelong health
- Critical windows of brain development
- Habits are established
- Food preferences are hardened
3 primary studies

- BMI in 445 people with FASD vs. controls (ages 2-19)
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Impulsivity & Poor Behavior Regulation

![Graph showing the relationship between Effortful Control and % kcal Fat. The graph indicates a negative correlation, with points scattered below the line, suggesting that higher Effortful Control is associated with lower % kcal Fat.]
Abnormal Eating Behaviors Are Common in Children with Fetal Alcohol Spectrum Disorder

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Objective To compare the eating behaviors and nutrition-related concerns in children with fetal alcohol spectrum disorder (FASD) with those in typically developing children.

Study design A survey that assessed eating behaviors was completed between October 2013 and May 2014 by the caregivers of children screened for FASD at the University of Minnesota’s Fetal Alcohol Spectrum Disorders Program, and typically developing children recruited from that clinic or from the Research Participation Core of the Waisman Center, University of Wisconsin.

Results Compared with controls (N = 81), children with FASD (N = 74) had delayed acquisition of self-feeding behavior (P < .001) and solid food introduction (P < .001). Impaired satiety was common and independent of medication use; 23.0% were never full/satisfied, 31.1% snacked constantly, and 27.0% concealed food (all P < .002). They consumed the equivalent of an additional meal/snack daily (P < .01). Children with FASD were more likely to have a past diagnosis of underweight (P < .001). Mean body mass index was significantly reduced for males (P = .009) but not females (P = .775) with FASD, and only 2 children with FASD were currently underweight. Children with FASD were more physically active (P < .01).

Conclusions Abnormal eating patterns are common in children with FASD and may contribute to their delayed growth and nutritional inadequacies. Their poor satiety may reflect poor impulse control. Children with FASD may benefit from diet counseling. Conversely, some children with hyperphagia may warrant referral for FASD screening. (J Pediatr 2016;163:194-200).
Eating behavior in FASD

- Survey of 74 with FASD vs. 81 non-FASD (MN and WI)
- Impaired satiety (23% reported often not being full/satisfied)
- Excessive snacking (31% reported constant snacking)
- Mildly increased oral aversion / texture sensitivity in FASD
- Disturbances in mealtime regularity were noted:
  - Eating too quickly, disinterested in mealtime, leaves table, poor appetite, problems using silverware, pickiness, eating non-food items
  - Families reported difficulty dining out (behavior), poor table manners, etc.
- This study found underweight in FASD males and no increase in obesity
More snacking in children with FASD

Afternoon / evening snacking was common
Seek help early for pickiness & preferences for high fat and sweet foods
Use multiple small exposures to new foods over time
  - Ensure a variety of tastes and textures
  - Revisit “rejected” foods in a non-threatening, non-coercive manner
Have consistently-timed family meals
Reduce snacking; use nutritional snacks
Avoid high calorie beverages
Control portion sizes (parents, serving size, apps, etc.)
Regular physical activity
  - Individual sports instead of team sports
  - Patterned, routine exercise
Thank you!