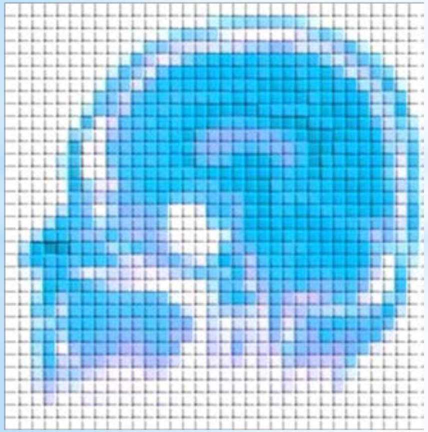
Associations between prenatal alcohol exposure, behavior, diet, and obesity



Jeffrey R. Wozniak, Ph.D. (University of Minnesota)
Anita J. Fuglestad, Judith K. Eckerle, Birgit A. Fink, Susan M. Smith, Christopher J. Boys, Steven H. Zeisel, and Michael K. Georgieff

Robyn Amos-Kroohs, Carol J. Smith, Lyanne Chin, Sandra Van Calcar, Susan M. Smith **(UNC and UW-Madison)**

CENTER FOR neuroBEHAVIORAL DEVELOPMENT

UNIVERSITY OF MINNESOTA Driven to Discover℠

NIH National Institute on Alcohol Abuse and Alcoholism

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

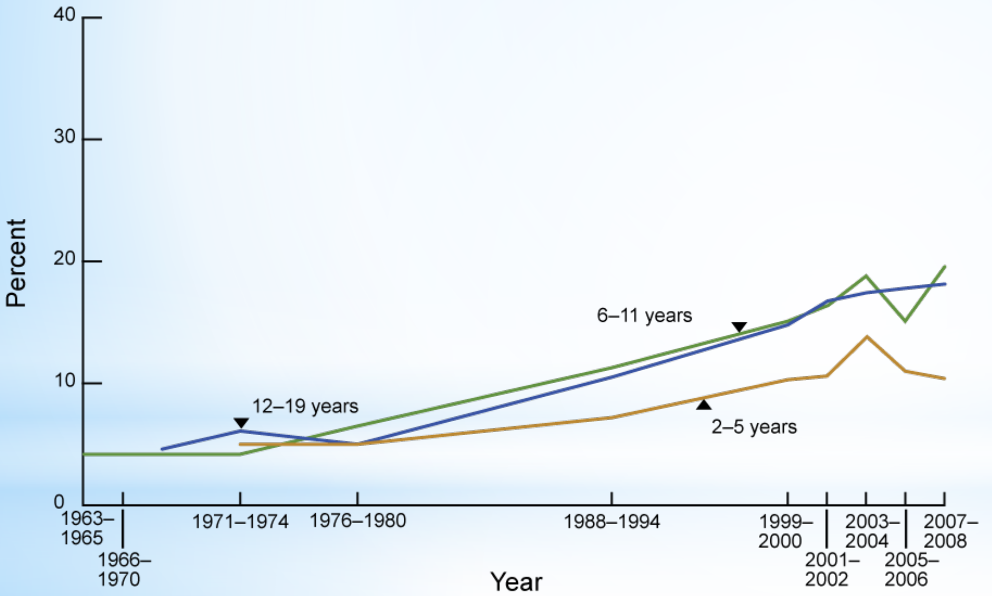
- NOTE: Studies of youth are relevant because there is a developmental impact on adult behavior and health


FASD in Minnesota
FASD is common.
FASD is costly.
FASD is preventable.
#FASDadvocate


make it happen
mofas.org/donate
THANK YOU

Child and Adolescent Obesity

Figure 1. Trends in obesity among children and adolescents: United States, 1963–2008



NOTE: Obesity is defined as body mass index (BMI) greater than or equal to sex- and age-specific 95th percentile from the 2000 CDC Growth Charts.
SOURCES: CDC/NCHS, National Health Examination Surveys II (ages 6–11), III (ages 12–17), and National Health and Nutrition Examination Surveys (NHANES) I–III, and NHANES 1999–2000, 2001–2002, 2003–2004, 2005–2006, and 2007–2008.

1 in 3 children are overweight or obese by their 5th birthday

Study 1: BMI in FASD

- 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?

Increased risk in FASD?

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)

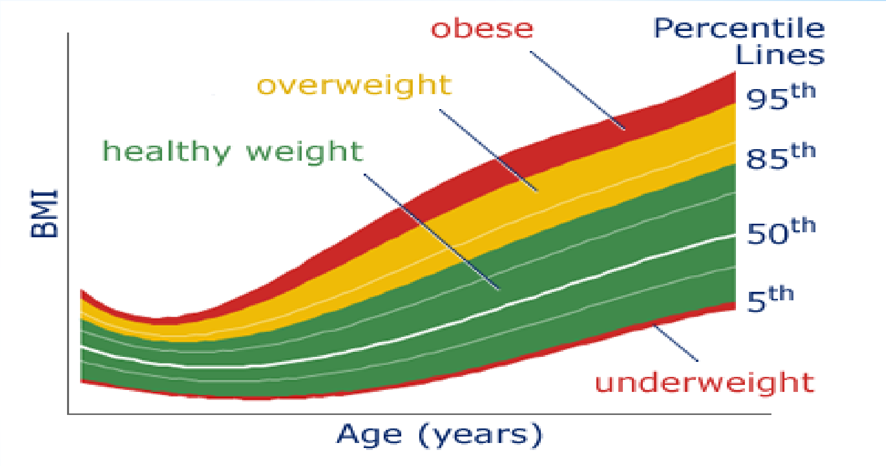
Prenatal alcohol and metabolic disturbance

- 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 (advantages over traditional control group)



Weight Categories:

Overweight & obese: BMI ≥ 85th percentile

Underweight: BMI <5th percentile

ALCOHOLISM: CLINICAL AND EXPERIMENTAL RESEARCH

Vol. **, No. *
** 2014

Overweight and Obesity Among Children and Adolescents with Fetal Alcohol Spectrum Disorders

Anita J. Fuglestad, Christopher J. Boys, Pi-Nian Chang, Bradley S. Miller, Judith K. Eckerle, Lindsay Deling, Birgit A. Fink, Heather L. Hoecker, Marie K. Hickey, Jose M. Jimenez-Vega, and Jeffrey R. Wozniak

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 ($n = 42$).

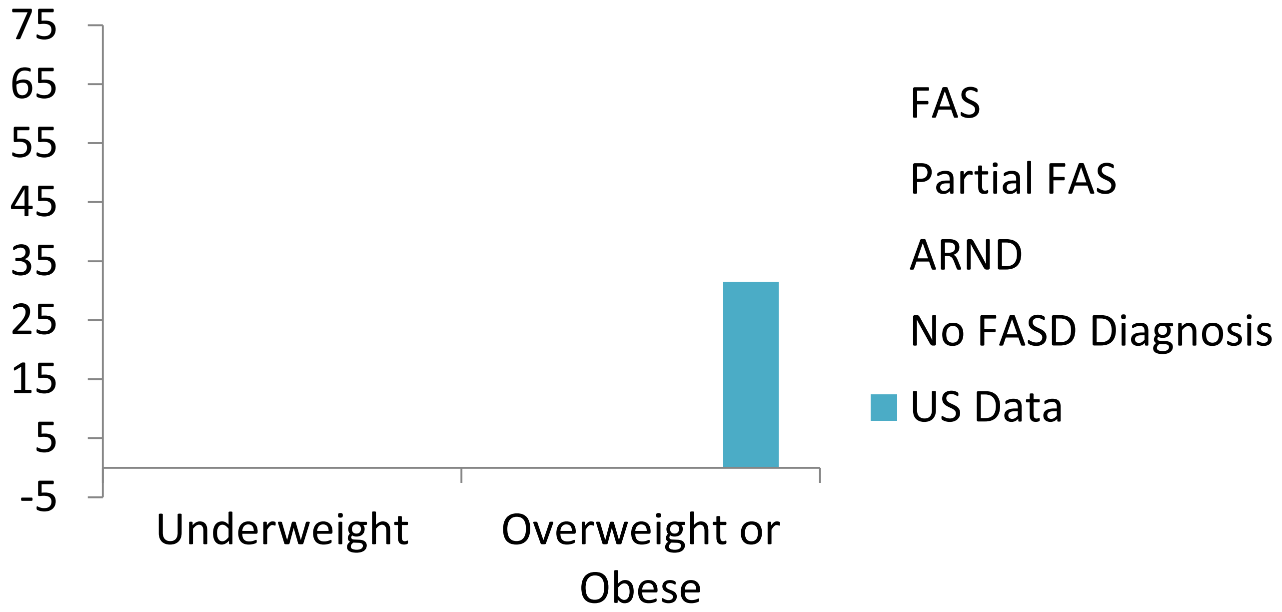
Results: Thirty-four percent with any FASD diagnosis were overweight or obese, which did not differ from the No-FASD group or U.S. prevalence. Underweight was prevalent in those with fetal alcohol syndrome (FAS) (17%). However, increased rates of overweight/obesity were seen in those with partial FAS (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.

GAL & EXPERIMENTAL RESEARCH

BMI compared to US Data



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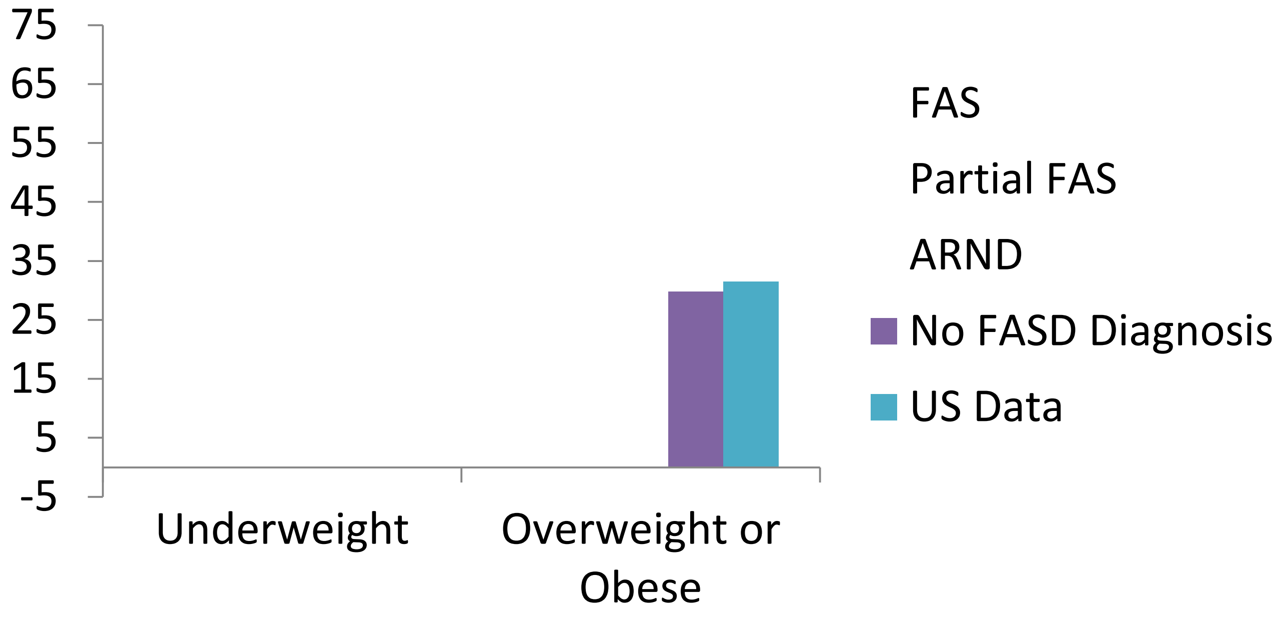

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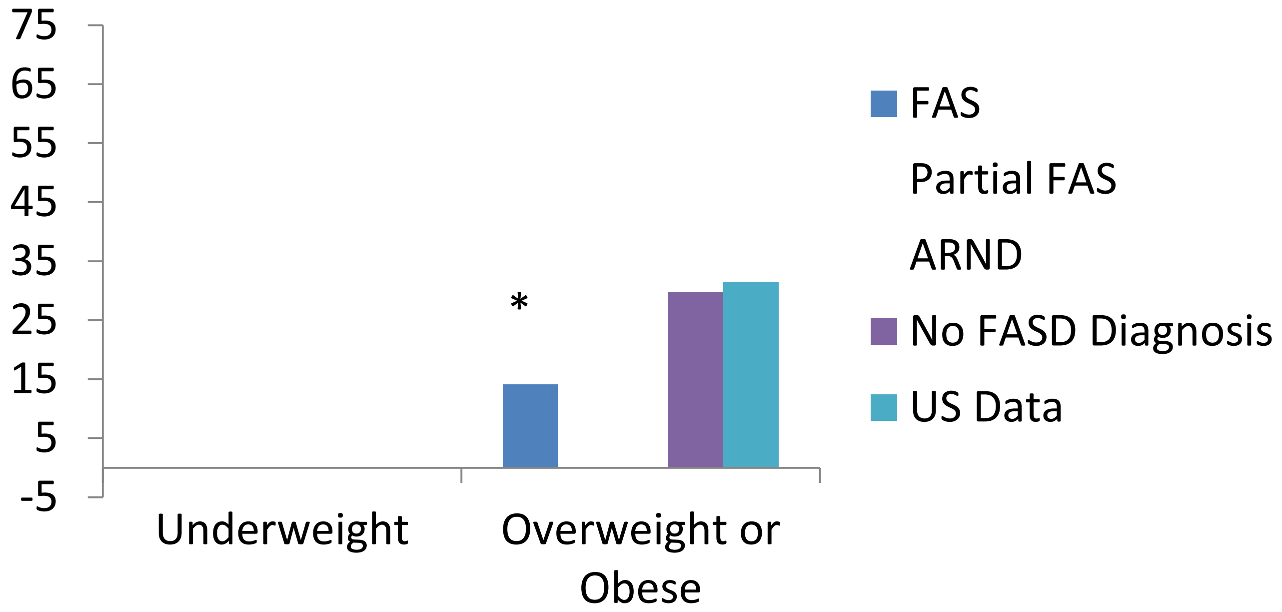

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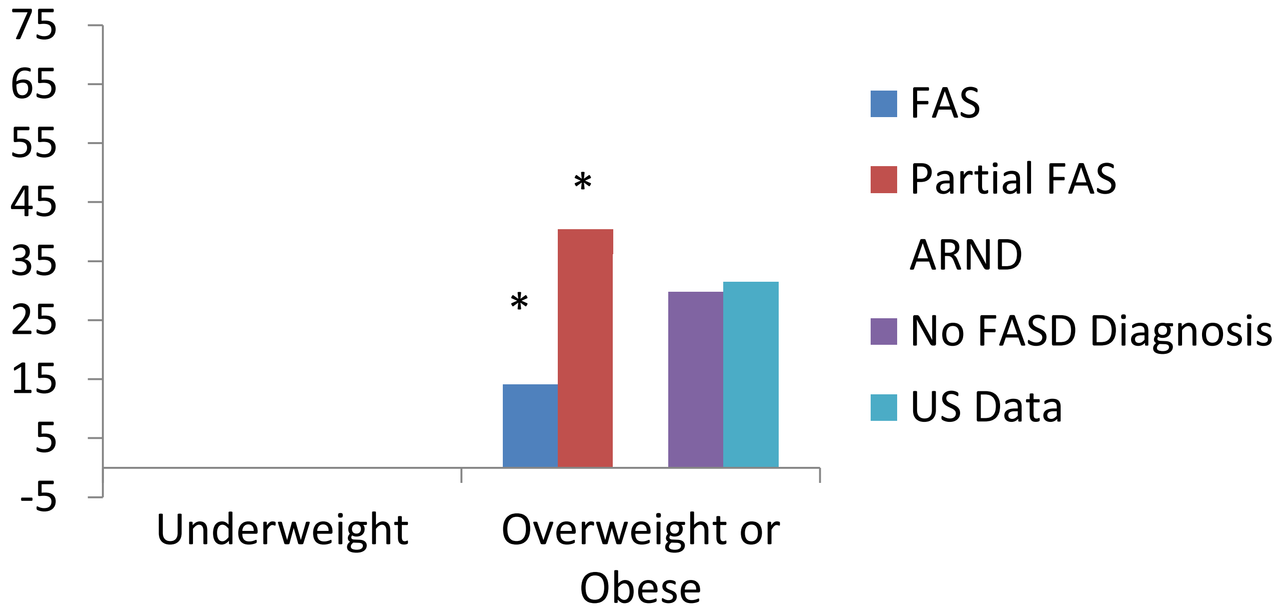
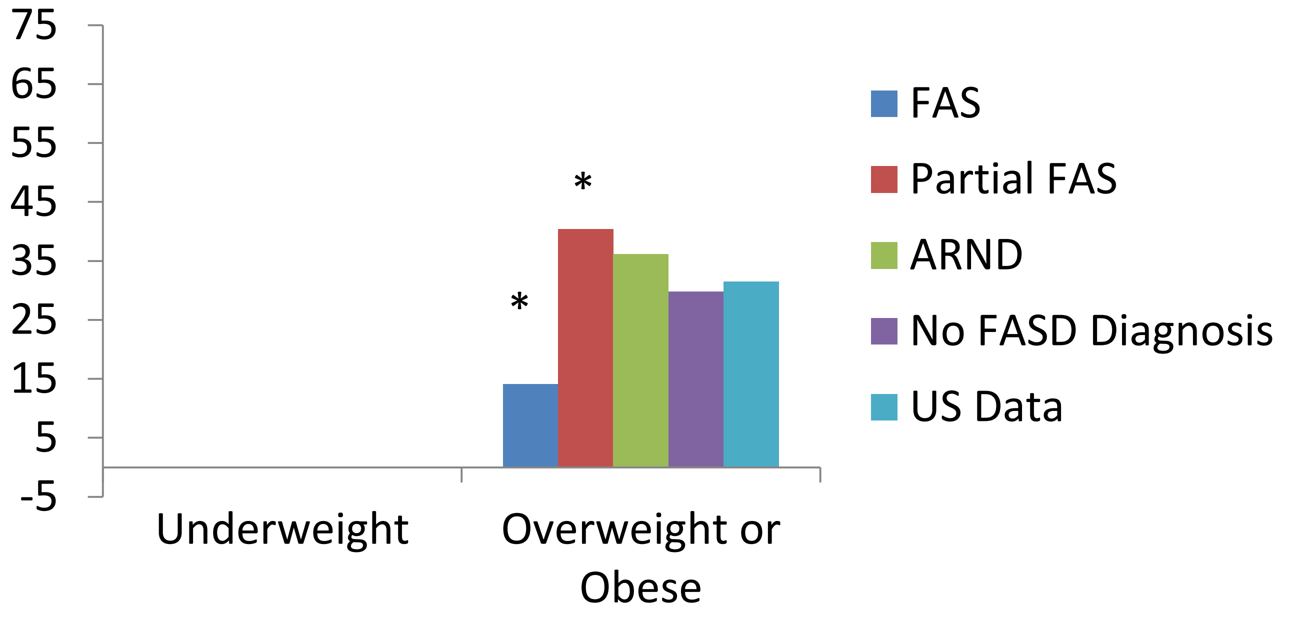
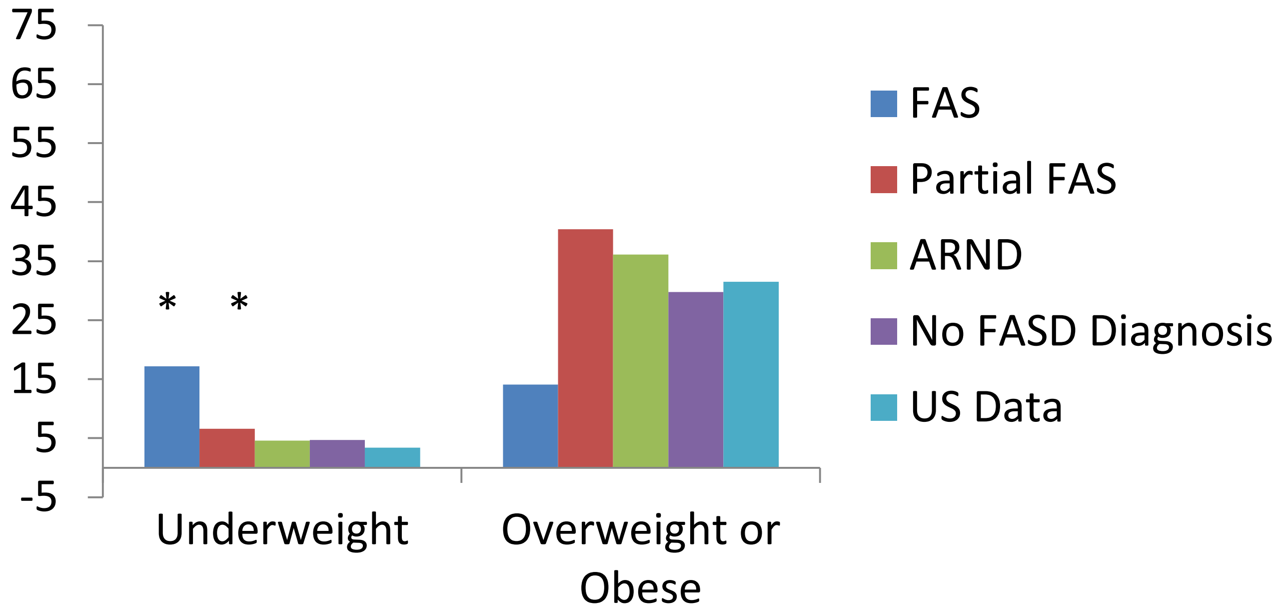


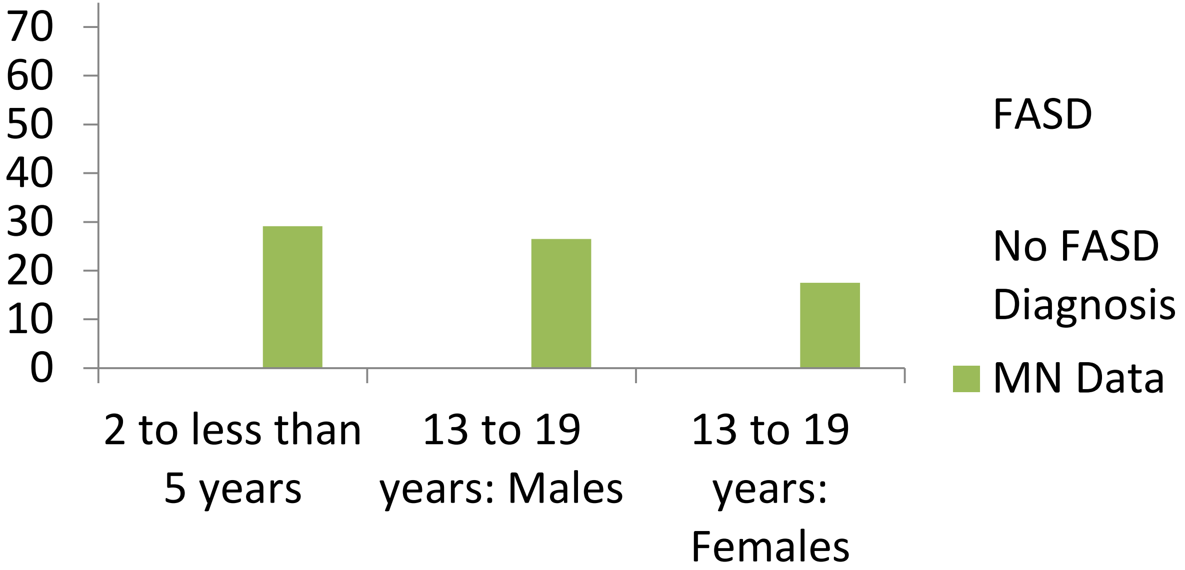
BMI compared to US Data



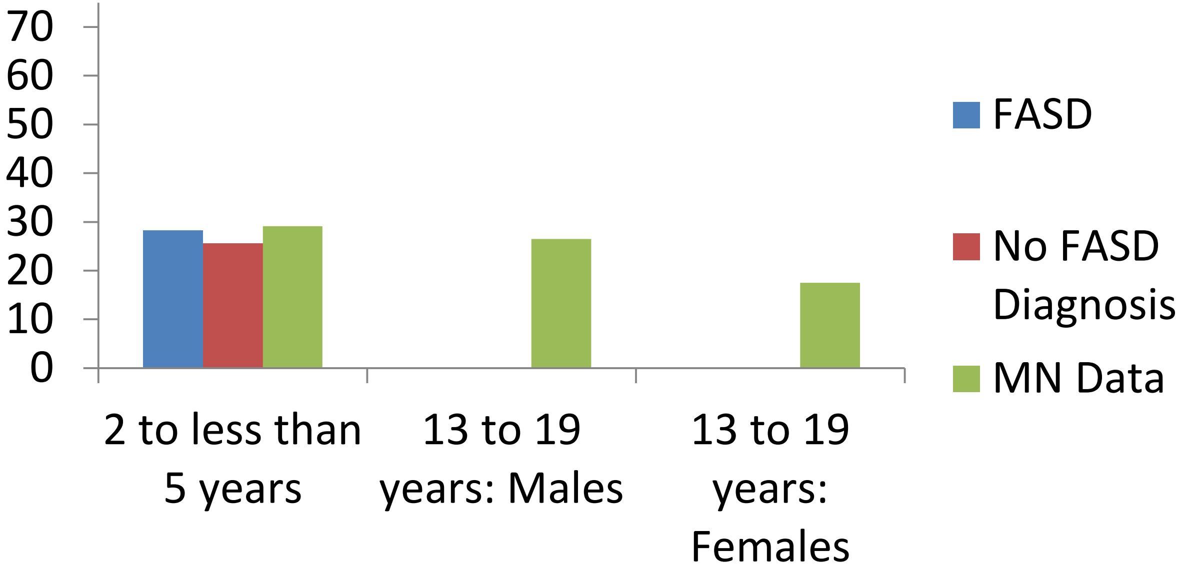
BMI compared to US Data



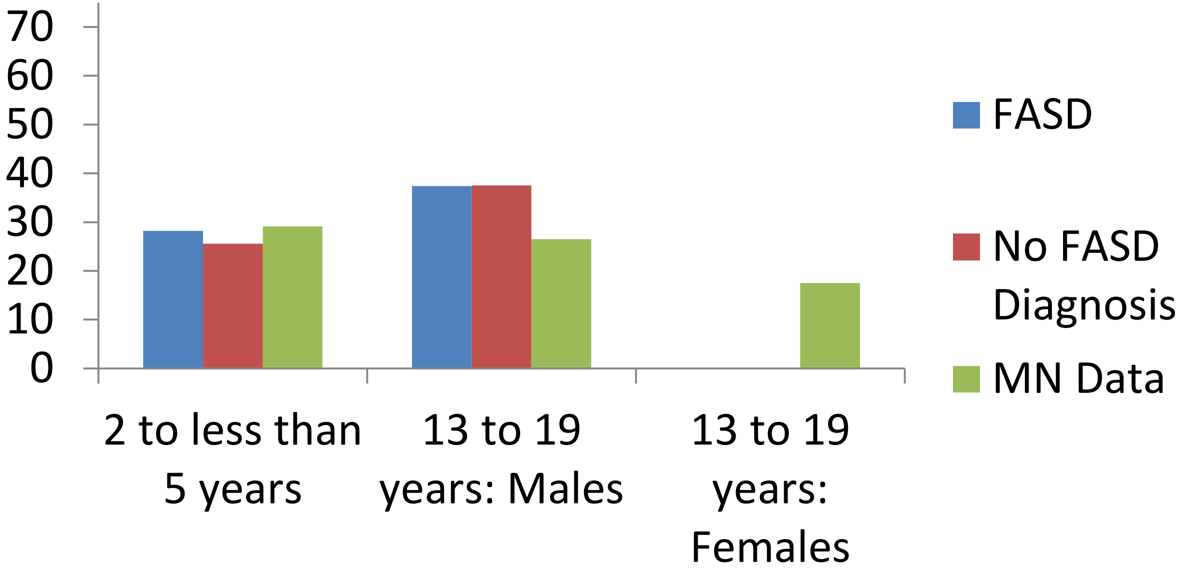
BMI compared to MN data



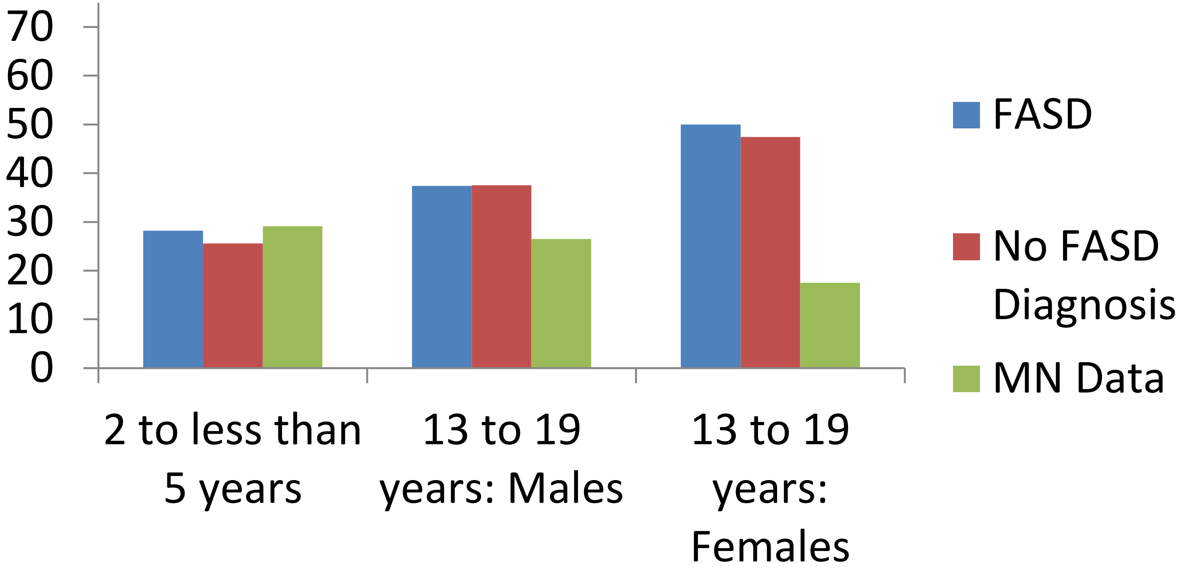
BMI compared to MN data



BMI compared to MN data

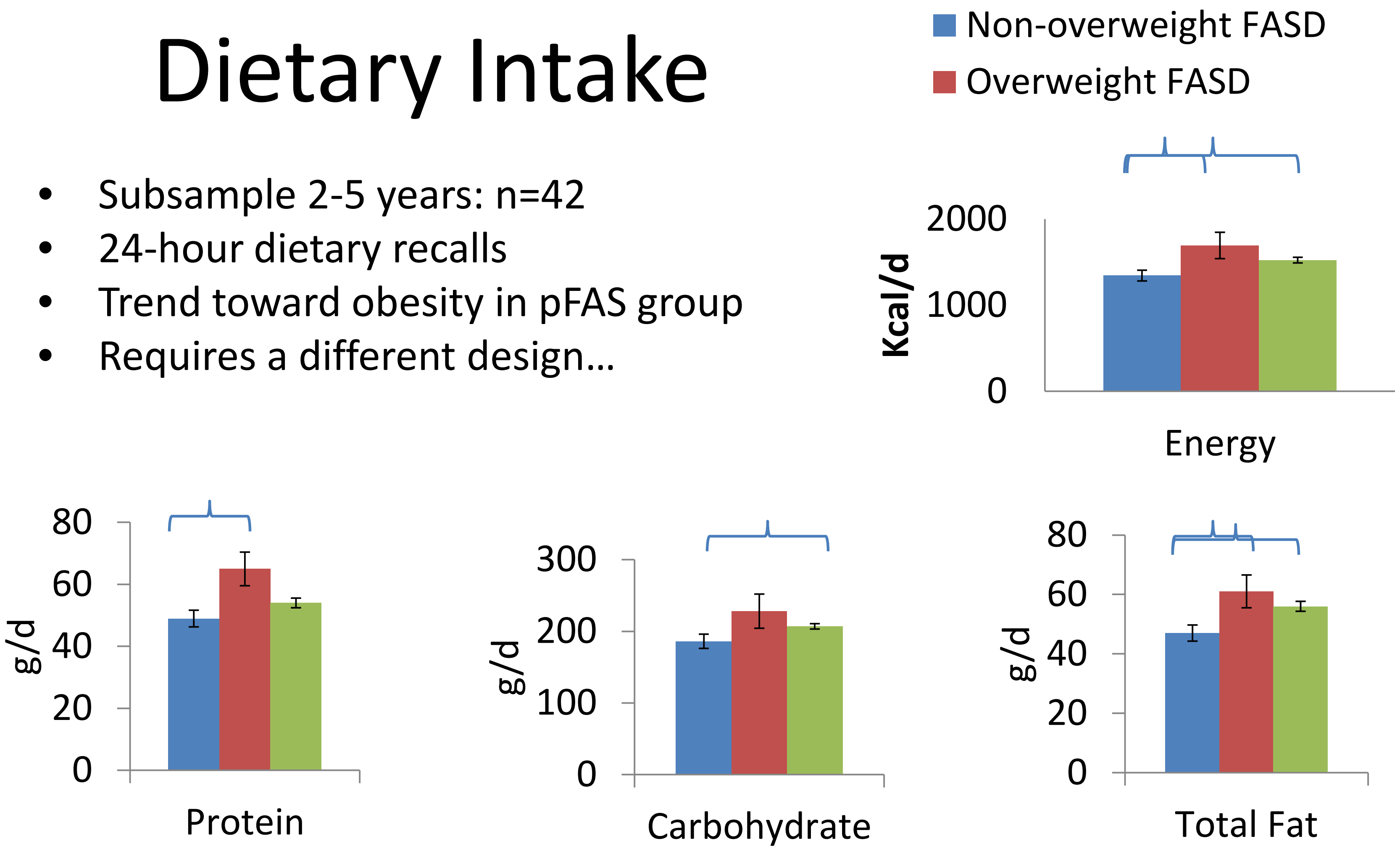


BMI compared to MN data



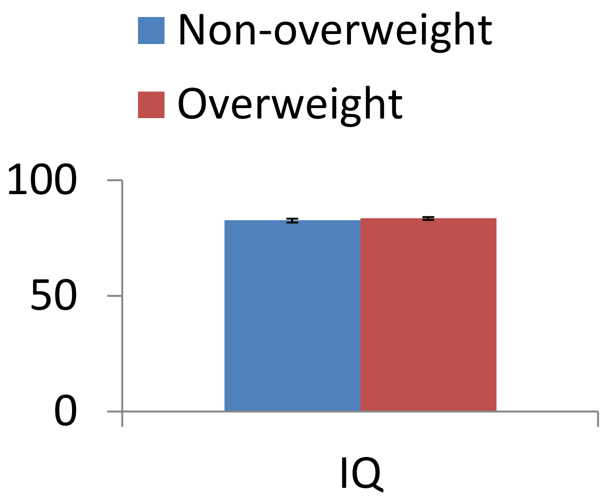
Dietary Intake

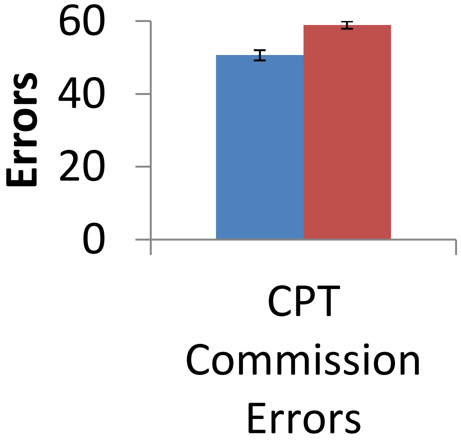
- Subsample 2-5 years: n=42
- 24-hour dietary recalls
- Trend toward obesity in pFAS group
- Requires a different design…

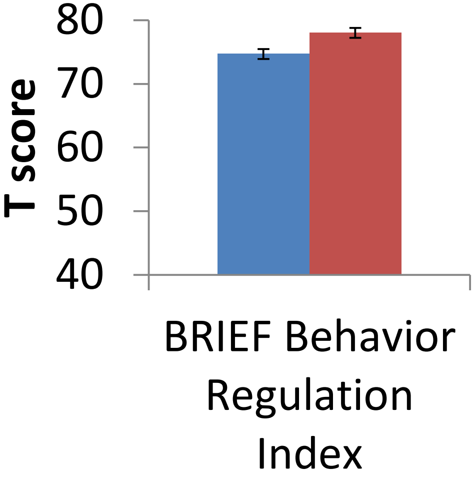


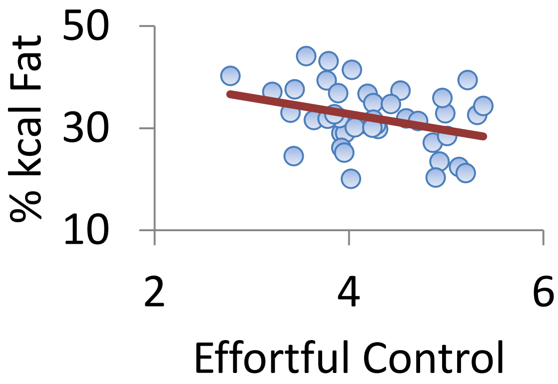
Impulsivity & Poor Behavior Regulation

Neuropsychological data









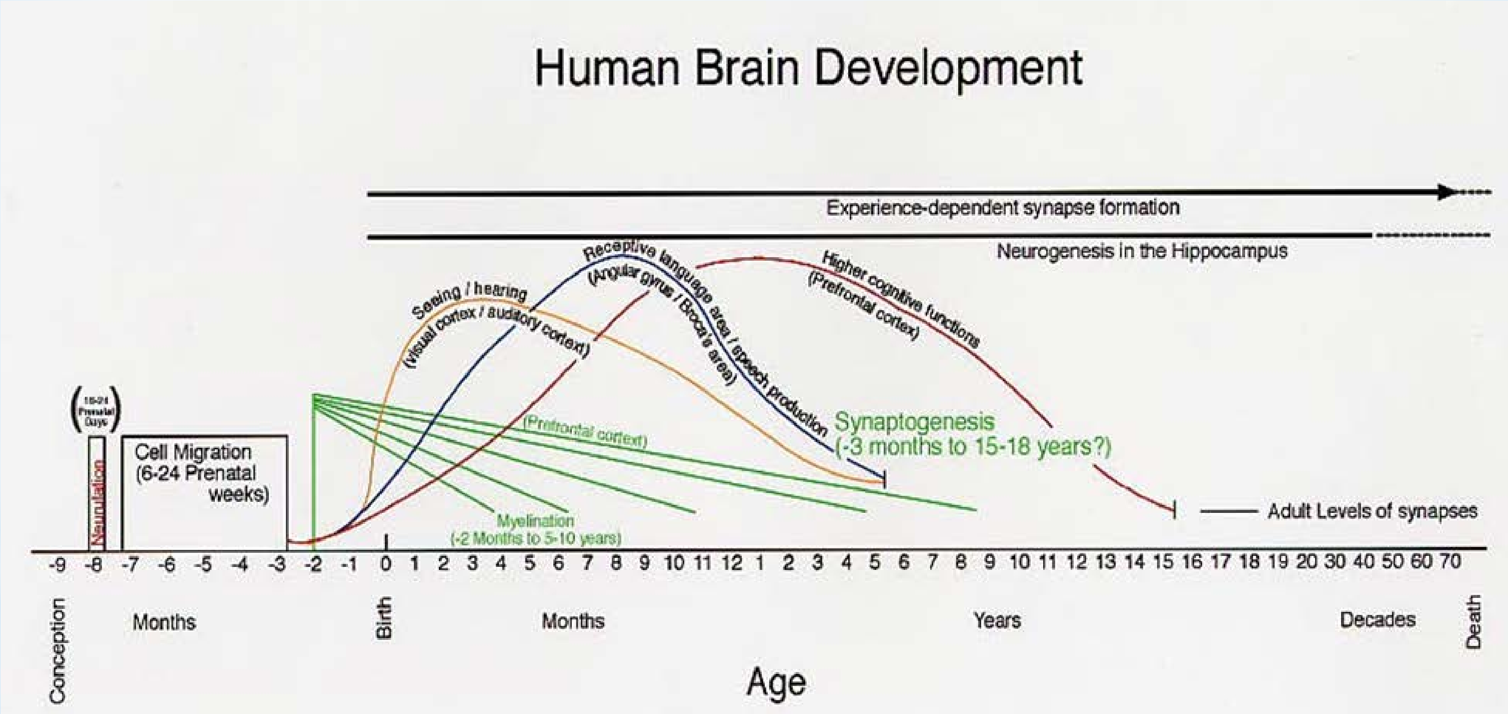
Summary of Overweight & Obesity

- 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

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

Nutrition and brain development



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

NUTRITION RESEARCH 33 (2013) 897–904

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Nutrition Research

Choline supplementation in children with fetal alcohol spectrum disorders has high feasibility and tolerability

Jeffrey R. Wozniak[a,*], *Anita J. Fuglestad*[a], *Judith K. Eckerle*[a], *Maria G. Kroupina*[a], *Neely C. Miller*[a], *Christopher J. Boys*[a], *Ann M. Brearley*[a], *Birgit A. Fink*[a], *Heather L. Hoecker*[b], *Steven H. Zeisel*[c], *Michael K. Georgieff*[a]

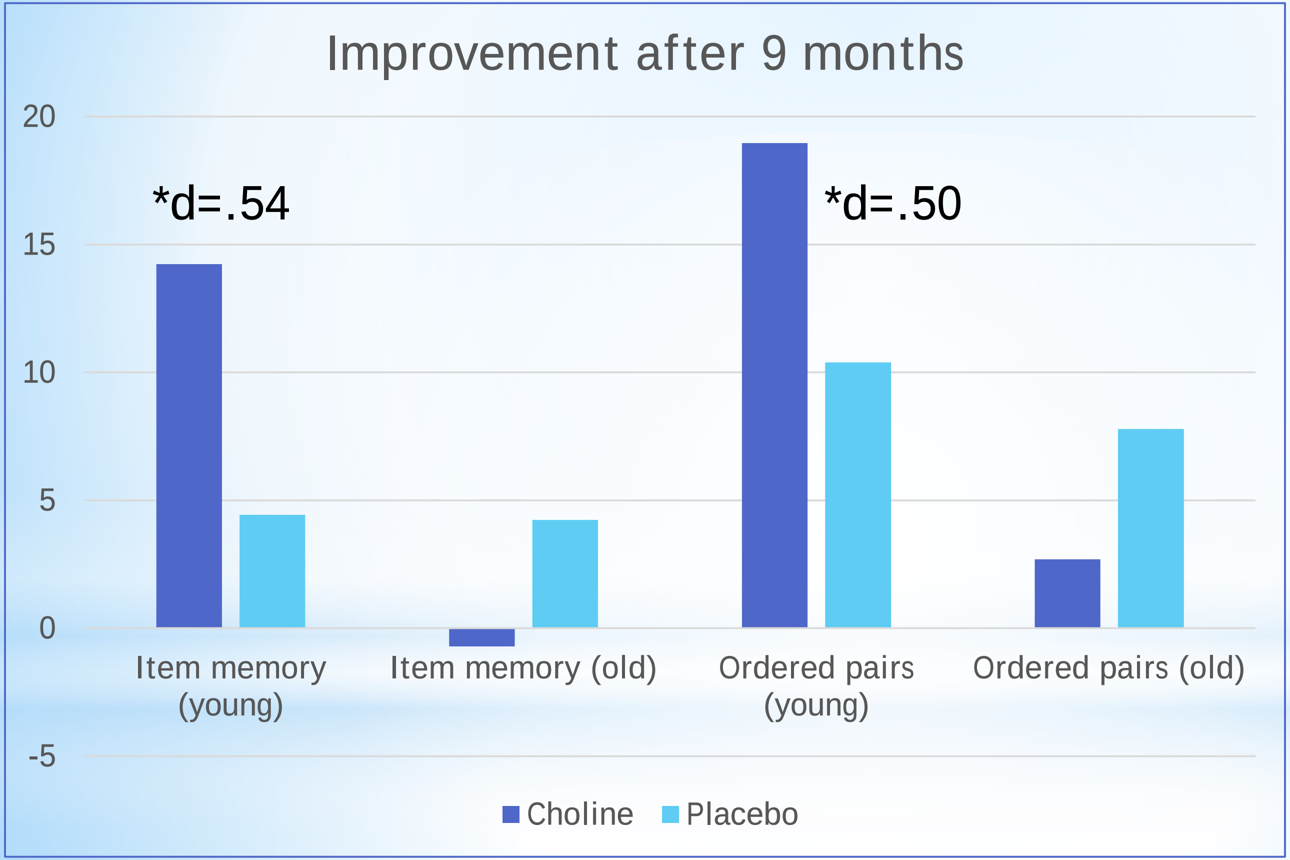
AJCN. First published ahead of print October 7, 2015 as doi: 10.3945/ajcn.114.099168.

Choline supplementation in children with fetal alcohol spectrum disorders: a randomized, double-blind, placebo-controlled trial[1,2]

Jeffrey R Wozniak,[3]* *Anita J Fuglestad,*[3] *Judith K Eckerle,*[4] *Birgit A Fink,*[3] *Heather L Hoecker,*[6] *Christopher J Boys,*[4] *Joshua P Radke,*[7] *Maria G Kroupina,*[4] *Neely C Miller,*[4] *Ann M Brearley,*[5] *Steven H Zeisel,*[8] *and Michael K Georgieff*[4]

[3]Department of Psychiatry, [4]Department of Pediatrics, and [5]Biostatistical Design and Analysis Center, University of Minnesota Twin Cities, Minneapolis, MN; [6]School of Public Health, Emory University, Atlanta, GA; [7]Fagron Inc., St. Paul, MN; and [8]University of North Carolina at Chapel Hill Nutrition Research Institute, Kannapolis, NC

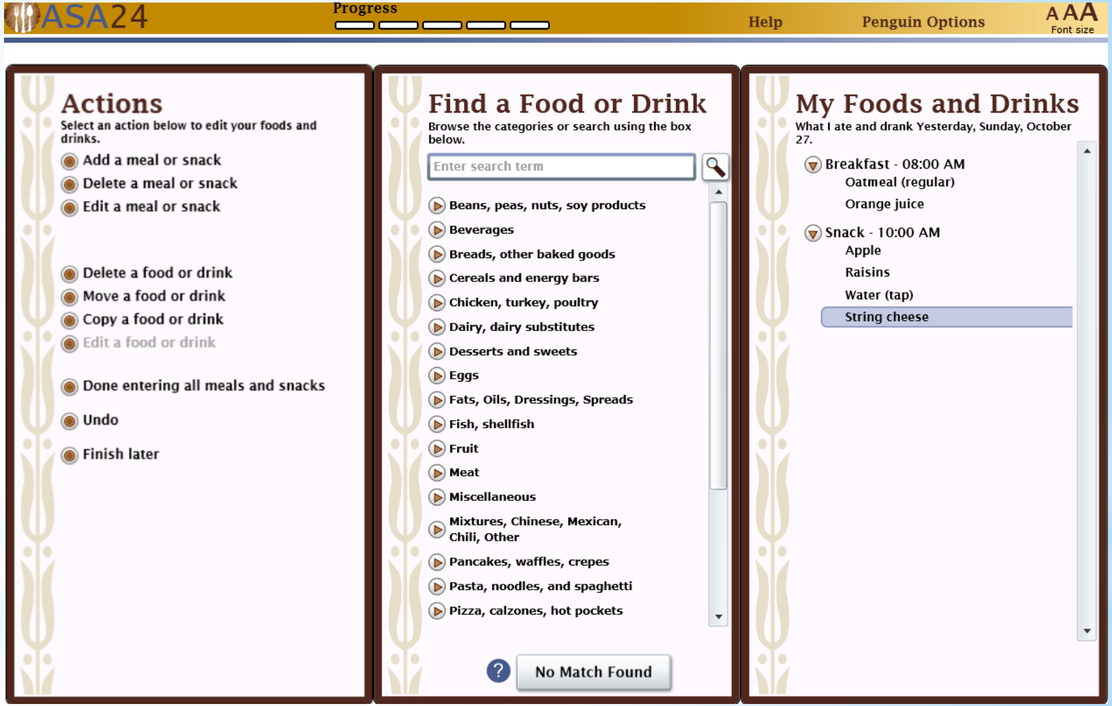
- 2 studies examining the role of nutrition as an intervention in FASD
- Choline affects gene expression, neurotransmitter synthesis, cell maintenance
- Ages: 2.5 to <5 years with FASD
- High feasibility and tolerability for choline supplementation for 9 months
- Modest improvement in memory for youngest children (2-3 year olds)
- Latest data (unpublished) suggests severely impacted may be more responsive



Elicited imitation memory performance: Baseline to 9 months

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



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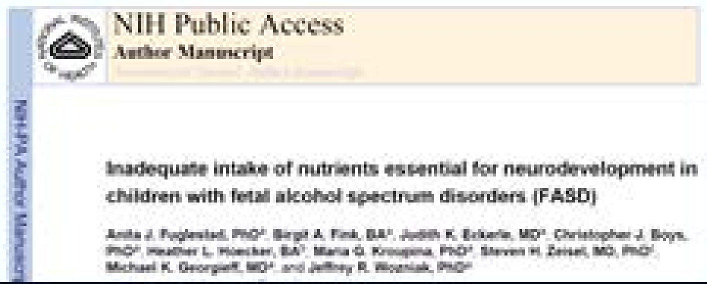
Neurotoxicol Teratol. Author manuscript.

Inadequate intake of nutrients essential for neurodevelopment in children with fetal alcohol spectrum disorders (FASD)

Anita J. Fuglestad, PhD[a], Birgit A. Fink, BA[a], Judith K. Eckerle, MD[a], Christopher J. Boys, PhD[a], Heather L. Hoecker, BA[b], Maria G. Kroupina, PhD[a], Steven H. Zeisel, MD, PhD[c], Michael K. Georgieff, MD[a], and Jeffrey R. Wozniak, PhD[a]

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

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

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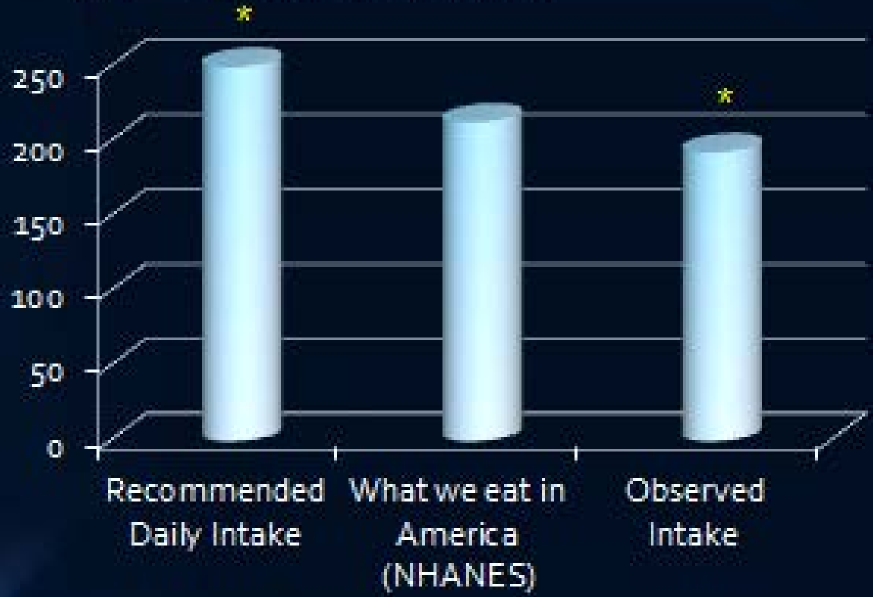

>84% of participants had inadequate levels of dietary choline intake (ASA-24)

Dietary intake: conclusions

- 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)
- Diet in 31 children with FASD (ages 2-5)
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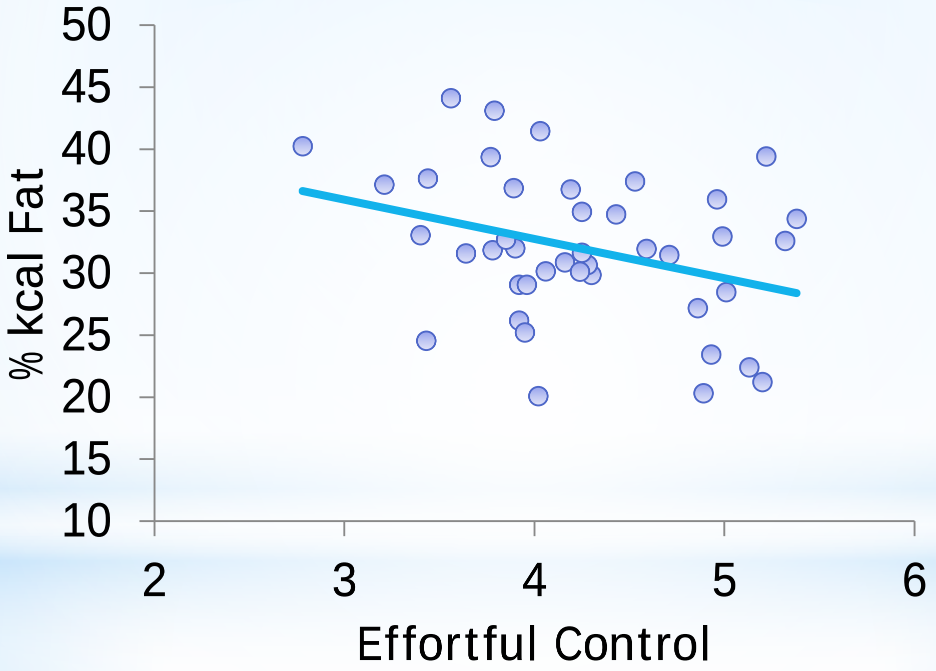
Impulsivity & Poor Behavior Regulation



Eating behavior in FASD

ORIGINAL ARTICLES

www.jpeds.com • THE JOURNAL OF PEDIATRICS

Abnormal Eating Behaviors Are Common in Children with Fetal Alcohol Spectrum Disorder

Robyn M. Amos-Kroohs, PhD[1], Birgit A. Fink, BA[2], Carol J. Smith, BS[1], Lyanne Chin, BS[1], Sandra C. Van Calcar, PhD, RD[3], Jeffrey R. Wozniak, PhD[2], and Susan M. Smith, PhD[1,3]

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 $P \leq .002$). 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 ($P < .01$).

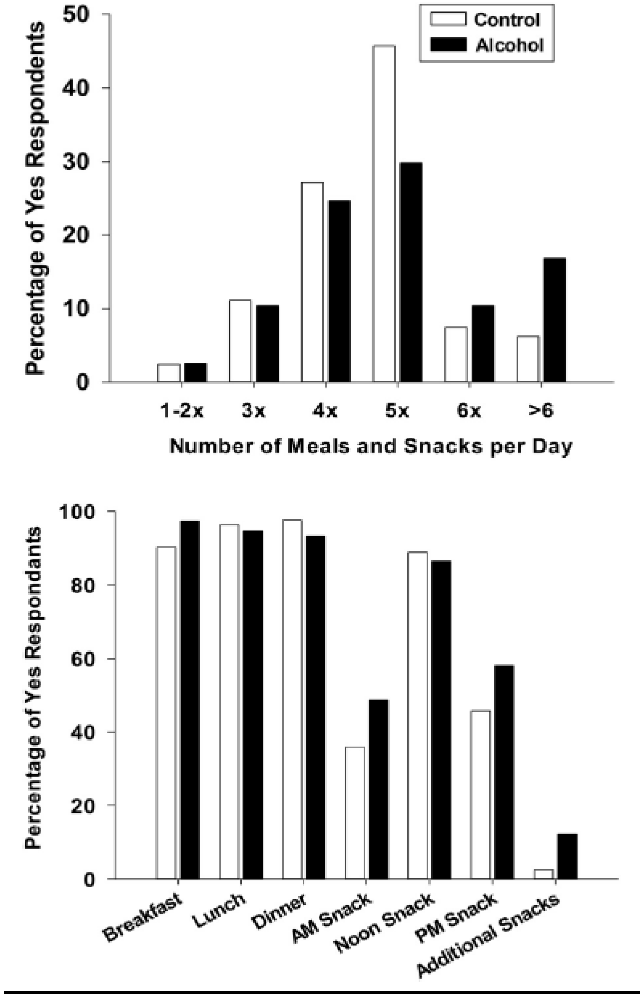
Conclusions Abnormal eating patterns are common in children with FASD and may contribute to their delayed growth and nutritional inadequacies. Their poor satiety may reflect poor impulse control. Children with FASD may benefit from diet counseling. Conversely, some children with hyperphagia may warrant referral for FASD screening. *(J Pediatr 2016;169:194-200).*

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

Snacking

- More snacking in children with FASD
- Afternoon / evening snacking was common



Advice

- 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!

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