

Supplementary Online Content

Bresnahan M, Hornig M, Schultz AF, et al. Association of maternal report of infant and toddler gastrointestinal symptoms with autism: evidence from a prospective birth cohort. *JAMA Psychiatry*. Published online March 25, 2015.

doi:10.1001/jamapsychiatry.2014.3034.

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Selected Population-Based Studies, 2008-2013

Study	Design	N	Age (years)	ASD diagnosis	Source of GI data	Associations	X1	X2
Ibrahim (2009) ²	Case/Control	ASD=121; Control=242	<21	ASD: DSM-IV	Medical records	Any GI (lifetime) ^a	ns	--
						DH (lifetime)	ns	--
						CO (lifetime)	+	--
						FI/FS (lifetime)	+	--
Sandhu (2009) ³	Cohort	Cohort=12,984; ASD=78	Birth-3.5	ASD: ICD-10	Maternal report	DH (6-18 months)	ns	--
						DH (18-30 months)	ns	--
						DH (30-42 months)	+	--
Mouridsen (2010) ⁴	Case/Control	IA=118; Control=336	2-57	IA: ICD-8,-10	Medical records	Any GI ^b	ns	--
Chandler (2013) ⁵	Case/Control	ASD=132; TD (X1)=82; SN (X2)=81	10-14	ASD: ICD-10	Maternal report	Any GI (lifetime) ^c	+	+
						DH (past)	+	+
						DH (current)	ns	ns
						CO (past)	--	--
						CO (current)	ns	+
Chaidez (2014) ⁶	Case/Control	ASD=499; TD (X1)=324; DD (X2)=137	2-5	ASD: ADI-R/ADOS	Maternal report	Any GI (current) ^d	+	+
						DH (current)	+	ns
						CO (current)	+	+
						SF (current)		

Key: **ADI-R**, Autism Diagnostic Interview – Revised; **ADOS**, Autism Diagnostic Observation Schedule; **ASD**, autism spectrum disorder; **CO**, constipation; **DD**, developmentally delayed; **DH**, diarrhea; **DSM-IV**, Diagnostic and Statistical Manual-IV; **FI/FS**, feeding issues/food selectivity; **GI**, gastrointestinal; **IA**, Infantile Autism; **ICD**, International Classification of Diseases – 8th, 10th edition; **SF**, sensitivity to foods; **SN**, special needs; **TD**, typically developing children; **X1**, comparison with control group 1; **X2**, comparison with control group 2; **ns**, not significant; +, significant association; --, not reported/not studied.

- ^a any DH, CO, abdominal discomfort/irritability, vomiting/reflux, feeding issues/food selectivity
- ^b any GI disorders (ICD-8 520.09-577.99, ICD-10 K00-K93.8), GI symptoms (ICD-8 784.09-785.89, ICD-10 R10-R19)
- ^c any current or past DH, current or past abdominal pain, current or past persistent vomiting, current CO, past stool withholding, past mouth ulcers, current soiling, current blood in stools, current mucus in stools
- ^d any abdominal pain, gas/bloating, DH, CO, pain on stooling, vomiting, sensitivity to foods, difficulty swallowing, blood in stools, blood in vomit

eTable 2. Gastrointestinal Symptoms in Children With Developmental Delay vs Children With Typical Development

	Developmental Delay vs. Typical Development	
	OR (95% CI)	aOR (95% CI)
6-18 Months		
Diarrhea	1.0 (1.0–1.1)	1.0 (0.9–1.1)
Constipation	1.2 (1.1–1.4)	1.3 (1.2–1.5)
Food Allergy/ Intolerance	1.2 (1.1–1.4)	1.1 (1.0–1.3)
Any GI Symptom	1.1 (1.0–1.2)	1.1 (1.0–1.1)
18-36 Months		
Diarrhea	1.2 (1.1–1.4)	1.1 (0.9–1.2)
Constipation	1.1 (1.0–1.2)	1.3 (1.2–1.4)
Food Allergy/ Intolerance	1.3 (1.1–1.4)	1.2 (1.1–1.3)
Any GI Symptom*	1.2 (1.1–1.3)	1.2 (1.1–1.3)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio; **aOR**, adjusted odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eTable 3. Longitudinal Gastrointestinal Symptoms in Children With Developmental Delay vs Children With Typical Development

	Developmental Delay vs. Typical Development	
	OR (95% CI)	aOR (95% CI)
Diarrhea		
None	Reference	Reference
6-18 months only	1.0 (1.0–1.1)	1.0 (0.9–1.1)
18-36 months only	1.5 (1.2–1.9)	1.3 (1.0–1.6)
Both	1.2 (1.0–1.4)	1.0 (0.8–1.2)
Constipation		
None	Reference	Reference
6-18 months only	1.2 (1.1–1.4)	1.3 (1.2–1.5)
18-36 months only	1.1 (1.0–1.2)	1.2 (1.1–1.4)
Both	1.3 (1.1–1.5)	1.5 (1.3–1.7)
Food Allergy/Intolerance		
None	Reference	Reference
6-18 months only	1.1 (1.0–1.3)	1.1 (0.9–1.3)
18-36 months only	1.3 (1.1–1.5)	1.2 (1.0–1.4)
Both	1.3 (1.1–1.5)	1.2 (1.0–1.4)
Any GI Symptom*		
None	Reference	Reference
6-18 months only	1.1 (1.0–1.1)	1.0 (1.0–1.1)
18-36 months only	1.2 (1.1–1.3)	1.3 (1.1–1.4)
Both	1.3 (1.1–1.4)	1.2 (1.1–1.4)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio; **aOR**, adjusted odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eTable 4. Gastrointestinal Symptoms in Children With Autism Spectrum Disorder vs Children With Developmental Motor Delay, Language Delay, and Motor and Language Delay

	ASD vs. MD only	ASD vs. LD only	ASD vs. MD & LD
	OR (95% CI)	OR (95% CI)	OR (95% CI)
6-18 Months			
Diarrhea	1.0 (0.8–1.4)	1.2 (0.9–1.6)	1.3 (0.9–1.8)
Constipation	2.0 (1.3–2.8)	2.0 (1.4–3.0)	1.0 (0.7–1.6)
Food Allergy/Intolerance	1.6 (1.0–2.5)	1.6 (1.0–2.5)	1.3 (0.8–2.2)
Any GI Symptom*	1.2 (0.9–1.7)	1.4 (1.0–1.9)	1.1 (0.8–1.6)
18-36 Months			
Diarrhea	2.4 (1.5–3.9)	2.1 (1.3–3.5)	1.5 (0.8–2.6)
Constipation	1.3 (0.9–1.9)	1.4 (1.0–2.0)	0.6 (0.4–1.0)
Food Allergy/Intolerance	1.7 (1.1–2.6)	2.0 (1.2–3.1)	1.2 (0.7–2.1)
Any GI Symptom*	1.8 (1.3–2.4)	1.9 (1.4–2.6)	0.9 (0.6–1.3)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eTable 5. Longitudinal Gastrointestinal Symptoms in Children With Autism Spectrum Disorder vs Children With Developmental Motor Delay, Language Delay, and Motor and Language Delay

	ASD vs. MD only	ASD vs. LD only	ASD vs. MD & LD
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Diarrhea			
None	Reference	Reference	Reference
6-18 months only	1.1 (0.7–1.3)	1.1 (0.8–1.5)	1.2 (0.8–1.8)
18-36 months only	2.5 (1.0–6.0)	1.5 (0.6–3.8)	1.1 (0.4–3.0)
Both	2.3 (1.3–4.1)	2.7 (1.5–4.9)	2.0 (1.0–4.0)
Constipation			
None	Reference	Reference	Reference
6-18 months only	1.6 (1.0–2.7)	1.7 (1.0–2.9)	1.2 (0.7–2.3)
18-36 months only	1.0 (0.6–1.6)	1.1 (0.7–1.8)	0.6 (0.3–1.0)
Both	2.4 (1.5–4.1)	2.5 (1.5–4.3)	0.8 (0.4–1.4)
Food Allergy/Intolerance			
None	Reference	Reference	Reference
6-18 months only	1.7 (0.9–3.3)	1.6 (0.8–3.2)	1.6 (0.7–3.6)
18-36 months only	1.9 (1.0–3.6)	2.6 (1.3–5.1)	1.4 (0.7–3.1)
Both	1.6 (0.9–2.9)	1.6 (0.9–3.0)	1.2 (0.6–2.3)
Any GI Symptom*			
None	Reference	Reference	Reference
6-18 months only	1.0 (0.7–1.5)	1.1 (0.8–1.6)	1.1 (0.7–1.6)
18-36 months only	1.4 (0.8–2.4)	1.4 (0.8–2.5)	0.7 (0.4–1.3)
Both	2.0 (1.3–2.9)	2.4 (1.6–3.6)	1.0 (0.7–1.6)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eTable 6. Gastrointestinal Symptoms in Children With Autistic Disorder, Asperger Syndrome, and PDD-NOS vs Children With Typical Development

	AD vs. TD	AS vs. TD	PDD-NOS vs. TD
	OR (95% CI)	OR (95% CI)	OR (95% CI)
6-18 Months			
Diarrhea	1.4 (0.9–2.1)	0.8 (0.4–1.5)	1.1 (0.7–1.8)
Constipation	2.4 (1.4–4.1)	0.7 (0.2–2.3)	3.3 (2.0–5.6)
Food Allergy/Intolerance	1.7 (0.8–3.3)	2.7 (1.2–6.1)	1.7 (0.8–3.6)
Any GI Symptom*	1.6 (1.0–2.5)	0.9 (0.5–1.7)	1.6 (1.0–2.6)
18-36 Months			
Diarrhea	2.3 (1.1–4.8)	4.3 (1.9–9.6)	2.3 (1.1–5.1)
Constipation	1.5 (0.9–2.6)	1.7 (0.8–3.5)	1.1 (0.6–2.1)
Food Allergy/Intolerance	2.3 (1.2–4.3)	2.5 (1.0–5.9)	1.9 (0.9–3.9)
Any GI Symptom*	2.0 (1.3–3.1)	2.7 (1.5–5.0)	1.7 (1.0–2.8)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eTable 7. Longitudinal Gastrointestinal Symptoms in Children With Autistic Disorder, Asperger Syndrome, and PDD-NOS vs Children With Typical Development

	AD vs. TD	AS vs. TD	PDD-NOS vs. TD
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Diarrhea			
None	Reference	Reference	Reference
6–18 months only	1.3 (0.8–2.1)	0.6 (0.3–1.3)	1.1 (0.7–1.8)
18–36 months only	2.4 (0.6–10.0)	3.8 (0.9–16.0)	2.5 (0.6–10.6)
Both	2.7 (1.1–6.4)	3.5 (1.3–9.2)	2.4 (0.9–6.1)
Constipation			
None	Reference	Reference	Reference
6–18 months only	1.9 (0.9–4.1)	0.4 (0.1–3.2)	3.1 (1.6–6.0)
18–36 months only	1.1 (0.6–2.3)	1.8 (0.8–3.9)	0.6 (0.2–1.6)
Both	3.1 (1.5–6.3)	1.2 (0.3–5.2)	3.2 (1.5–6.8)
Food Allergy/Intolerance			
None	Reference	Reference	Reference
6–18 months only	2.1 (0.9–5.3)	2.5 (0.8–8.3)	1.4 (0.4–4.5)
18–36 months only	3.6 (1.7–7.9)	2.1 (0.5–8.7)	1.7 (0.5–5.5)
Both	1.5 (0.5–4.1)	3.0 (1.1–8.4)	2.0 (0.8–5.1)
Any GI Symptom*			
None	Reference	Reference	Reference
6–18 months only	1.2 (0.7–2.1)	0.7 (0.3–1.6)	1.3 (0.8–2.4)
18–36 months only	1.3 (0.5–3.1)	2.6 (1.0–6.3)	1.2 (0.5–3.2)
Both	2.7 (1.5–4.7)	2.2 (1.0–4.8)	2.3 (1.3–4.3)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR** odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eTable 8. Gastrointestinal Symptoms in Children With Autistic Disorder, Asperger Syndrome, and PDD-NOS vs Children With Delayed Development

	AD vs. DD	AS vs. DD	PDD-NOS vs. DD
	OR (95% CI)	OR (95% CI)	OR (95% CI)
6-18 Months			
Diarrhea	1.3 (0.9–2.0)	0.8 (0.4–1.4)	1.1 (0.7–1.8)
Constipation	1.9 (1.1–3.3)	0.6 (0.2–1.8)	2.7 (1.6–4.6)
Food Allergy/Intolerance	1.4 (0.7–2.8)	2.2 (1.0–5.0)	1.4 (0.7–3.0)
Any GI Symptom*	1.5 (0.9–2.3)	0.8 (0.5–1.5)	1.5 (0.9–2.4)
18-36 Months			
Diarrhea	1.9 (0.9–3.9)	3.5 (1.5–7.9)	1.9 (0.9–4.2)
Constipation	1.4 (0.8–2.3)	1.5 (0.7–3.1)	1.0 (0.5–1.8)
Food Allergy/Intolerance	1.8 (1.0–3.5)	2.0 (0.8–4.7)	1.5 (0.7–3.1)
Any GI Symptom*	1.7 (1.1–2.6)	2.3 (1.2–4.2)	1.4 (0.9–2.3)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

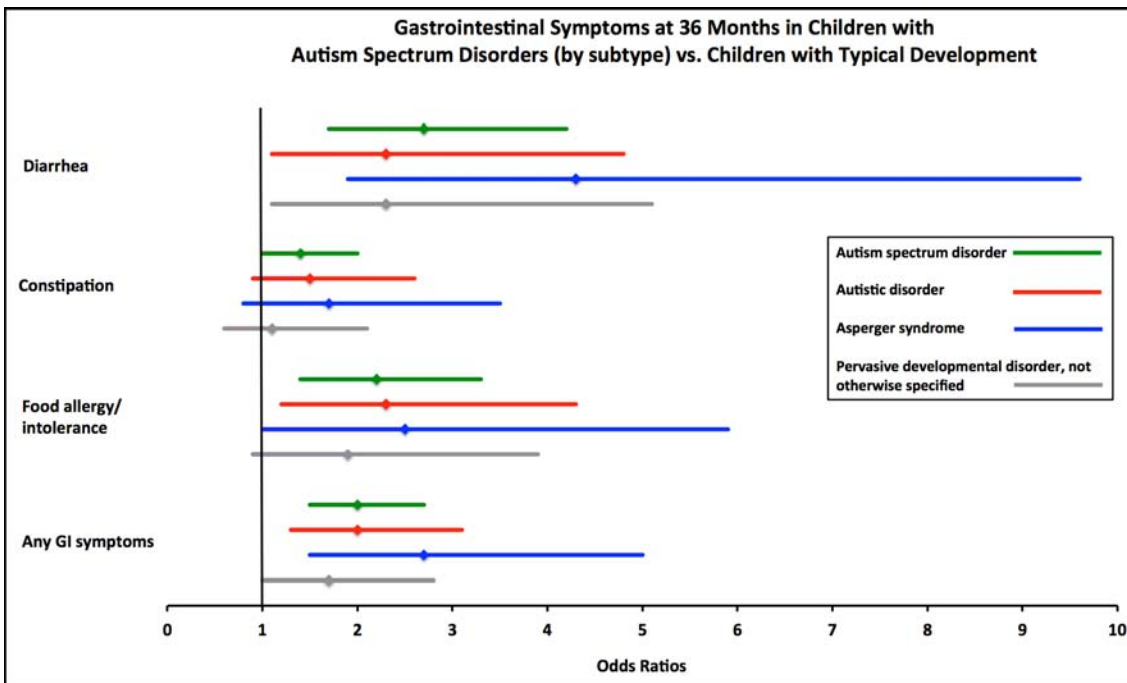
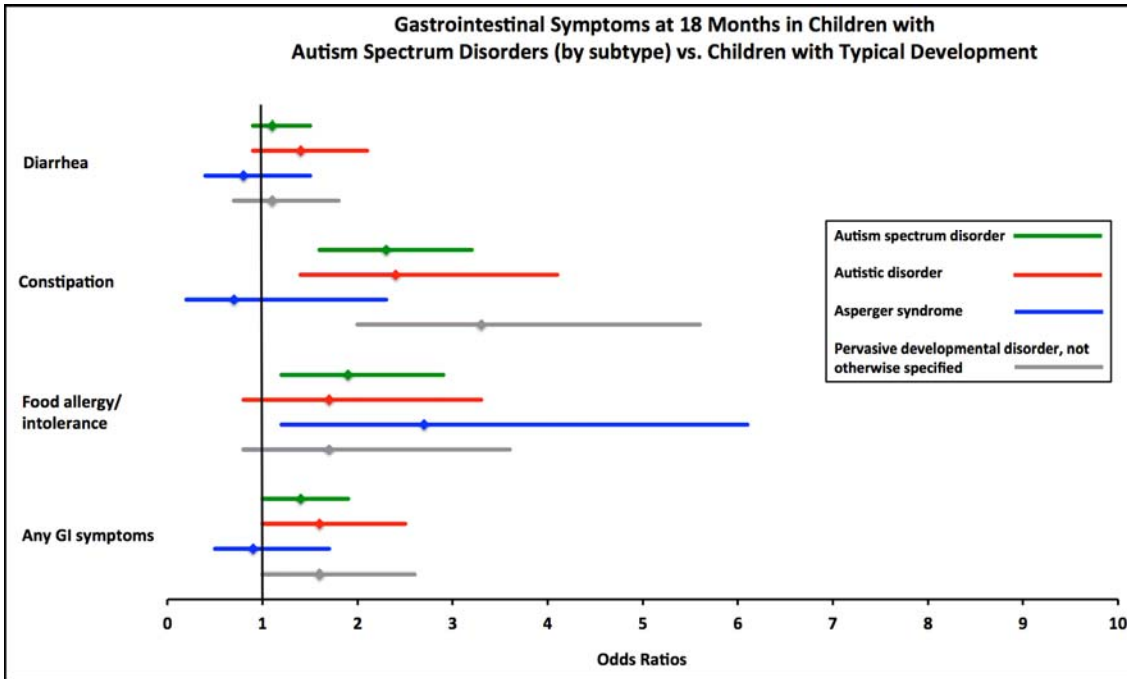
eTable 9. Longitudinal Gastrointestinal Symptoms in Children With Autistic Disorder, Asperger Syndrome, and PDD-NOS vs Children With Developmental Delay

	AD vs. DD	AS vs. DD	PDD-NOS vs. DD
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Diarrhea			
None	Reference	Reference	Reference
6-18 months only	1.3 (0.8–2.0)	0.6 (0.3–1.3)	1.1 (0.6–1.7)
18-36 months only	1.6 (0.4–6.9)	2.6 (0.6–11.0)	1.7 (0.4–7.3)
Both	2.3 (1.0–5.6)	3.0 (1.1–8.0)	2.0 (0.8–5.3)
Constipation			
None	Reference	Reference	Reference
6-18 months only	1.6 (0.7–3.3)	0.4 (0.0–2.6)	2.5 (1.3–4.9)
18-36 months only	1.0 (0.5–2.1)	1.6 (0.7–3.5)	0.5 (0.2–1.5)
Both	2.4 (1.2–5.0)	1.0 (0.2–4.1)	2.5 (1.2–5.4)
Food Allergy/Intolerance			
None	Reference	Reference	Reference
6-18 months only	1.9 (0.7–4.7)	2.2 (0.7–7.3)	1.2 (0.4–3.9)
18-36 months only	2.9 (1.3–6.4)	1.6 (0.4–6.9)	1.4 (0.4–4.4)
Both	1.2 (0.4–3.2)	2.3 (0.8–6.6)	1.6 (0.6–4.0)
Any GI Symptom*			
None	Reference	Reference	Reference
6-18 months only	1.1 (0.7–2.0)	0.7 (0.3–1.5)	1.3 (0.7–2.2)
18-36 months only	1.1 (0.4–2.7)	2.2 (0.9–5.4)	1.0 (0.4–2.7)
Both	2.2 (1.2–3.8)	1.8 (0.8–3.8)	1.9 (0.7–3.5)

Key: **CI**, confidence interval; **GI**, gastrointestinal; **OR**, odds ratio

*Any GI Symptom includes: diarrhea, constipation, and food allergy/intolerance

eFigure 1. Gastrointestinal Symptoms at 18 Months (A) and 36 Months (B) in Children With Autism Spectrum Disorders (by Subtype) vs Children With Typical Development



eFigure 2. Gastrointestinal Symptoms at 18 Months (A) and 36 Months (B) in Children With Autism Spectrum Disorders (by Subtype) vs Children With Developmental Delay

