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PREVALENCE OF GASTROINTESTINAL DYSFUNCTION AND FOOD SELECTIVITY AMONG SCHOOL-GOING CHILDREN WITH AUTISM SPECTRUM DISORDER AGED 4–16 YEARS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: Children with Autism Spectrum Disorder (ASD) frequently experience gastrointestinal (GI) dysfunction, food selectivity, sleep disturbances, sensory reactivity, and behavioral challenges. These comorbidities often coexist, yet limited Indian data explores their prevalence and interrelationship.

Aim: To estimate the prevalence of GI dysfunction and food selectivity among school-going autistic children and assess their associations with autism severity, sensory reactivity, sleep disturbances, and behavioral problems.

Materials and Methods: A cross-sectional analytical study was conducted among 300 children with ASD aged 4–16 years attending special schools in Chennai. Standardized, validated parent-report instruments were used: ISAA for autism severity, GISSI-17 and ROME IV for GI symptoms, BAMBI for feeding behavior, CSHQ for sleep disturbances, SSP for sensory reactivity, and BPI-01 for behavioral problems. Associations between GI dysfunction and other domains were analyzed using Chi-square and logistic regression.

Results: GI symptoms (GISSI-17 ≥34) were present in 40% of children, while GI dysfunction per ROME IV was noted in 36%. Food selectivity was observed in 35%, sleep disturbances in 33%, and sensory reactivity in 52%. Although GI dysfunction prevalence did not vary significantly across ASD severity groups, it showed strong associations with food selectivity ($p<0.001$), sleep problems ($p<0.001$), sensory reactivity ($p<0.001$), and behavioral challenges (OR 1.08 per BPI score increase, $p<0.001$). Functional constipation was the most common GI disorder (47%), with a severity-linked increase.

Conclusion: GI dysfunction is highly prevalent in children with ASD and closely interlinked with feeding challenges, sleep disturbances, sensory issues, and behavioral problems. These findings support a holistic, multidisciplinary approach to assessment and management, recognizing the interplay between medical and behavioral domains in autism care.

Keywords: Neurodevelopmental Disorders, Gastrointestinal Motility, Sleep Disorders, Feeding and Eating Disorders of Childhood, Child Behavior Disorders, Sensory Processing, Constipation.

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by persistent social communication deficits, restricted interests, repetitive behaviors, and atypical sensory processing (1). These core behavioural features can be associated with many co-occurring medical conditions such as anxiety disorders (2,3), sleep abnormalities (4,5), and gastrointestinal dysfunction, including gastrointestinal (GI) symptoms (6,7) and feeding disorders (8). all of which contribute to clinical heterogeneity (9).

The median prevalence of GI symptoms among children on the autism spectrum is about 46% (10,11), three times higher than their typically developing peers (12,13).

Functional constipation and abdominal pain are most commonly reported (6,14), with up to 30.6% of children experiencing multiple symptoms simultaneously(15). Food selectivity (FS), including limited food repertoire, refusal, and mealtime behavior disturbances, affects as many as 95% of autistic children (16,17). These somatic issues can exacerbate behavioral symptoms, including anxiety and aggression, and are linked with increased repetitive behaviors (12,18).

GI-related discomfort often presents through behavioral cues such as aggression or self-injury, particularly in nonverbal children (8). Symptoms like gastroesophageal reflux can disrupt sleep, further impairing quality of life (15).While sensory processing abnormalities have long been noted in ASD (19), emerging evidence suggests that sensory over- or under-reactivity may underlie or amplify GI symptoms, food selectivity, and sleep and behavioral challenges (20).

Despite the high burden of these symptoms, research exploring the interplay between GI dysfunction and associated behavioral, sensory, and sleep disturbances remains limited in India (21), This study aims to estimate the prevalence of GI dysfunction and food selectivity among school-going autistic children and assess their associations with autism severity, sensory reactivity, sleep habits, and behavioral challenges.

METHODOLOGY

Study Design and Setting

This was an analytical cross-sectional study conducted over a period of 18 months in special schools for children with autism located in Chennai, Tamil Nadu, India.

Study Population

Children aged 4 to 16 years with an existing diagnosis of Autism Spectrum Disorder (ASD), confirmed as per DSM-5 criteria, and attending designated autism special schools in Chennai were included. Written informed consent was obtained from parents or legal guardians.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by the **Institutional Ethics Committee (IEC) of [Insert Institute Name]**, reference number: [Insert Reference No.]. Participation was voluntary, and confidentiality was ensured throughout the study.

Sample Size Calculation

The sample size was determined using Dobson's formula (22):

$$n = \frac{z^2 \times p \times q}{d^2}$$

Where:

- Z = 1.96 (for 95% confidence)
- p = 34.5% (expected prevalence of GI symptoms (23).)
- q = 65.5% (100 – p)
- d = 5% (precision)

$$n = \frac{(1.96)^2 \times 34.5 \times 65.5}{25} = 347$$

Thus, a minimum sample size of 347 was required. A purposive sampling method was adopted. Although the calculated minimum required sample size was 347, a total of 300 participants only were enrolled during the study period due to practical constraints such as recruitment feasibility and parental consent rates. Despite the slightly lower sample size, the achieved number of 300 participants still provided an adequate power to analyze associations in this exploratory study.

Inclusion Criteria
- Children aged 4–16 years with a diagnosis of ASD (DSM-5 criteria).
- Currently enrolled in autism special schools in Chennai.
- Informed consent provided by parent or guardian.

Exclusion Criteria
- Children without ASD.
- Children co-diagnosed with other neurodevelopmental disorders.
- Children receiving ongoing treatment for GI symptoms (diet/medication) for more than 3 months.

Data Collection
Data were collected in two sessions by the principal investigator. In the first session, demographic details, autism severity (via ISAA), and gastrointestinal symptoms (via ATN GISSI-17 and ROME IV) were recorded. The second session, conducted telephonically, collected data on sleep habits, sensory reactivity, and challenging behaviors. Anthropometric measurements were taken during the first session.

Study Instruments
All questionnaires were pre-validated and administered to parents.

Table 1: Study Instruments Used for Assessment of Clinical Domains

Domain	Instrument
Autism severity	Indian Scale for Assessment of Autism (ISAA)
GI symptoms	ATN GISSI-17 and ROME IV Diagnostic Questionnaire
Food selectivity	Brief Autism Mealtime Behaviour Inventory (BAMBI)
Sleep disturbance	Children's Sleep Habits Questionnaire (CSHQ, abbreviated)
Sensory reactivity	Short Sensory Profile (SSP)
Challenging behavior	Behaviour Problem Inventory-01 (BPI-01)

Cut-off Scores Used:
- GI Dysfunction: GISSI-17 ≥34 and/or diagnosis per ROME IV
- Food Selectivity: BAMBI ≥34
- Sleep Disturbance: CSHQ ≥41
- Sensory Sensitivity: SSP indicating probable/definite difference
- Behavioral Challenges: Presence of self-injurious, stereotyped, or aggressive behaviors per BPI-01

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using SPSS version 23. Participants were categorized into two groups based on the presence or absence of gastrointestinal dysfunction. Descriptive statistics were presented as frequencies, percentages, and means. Chi-square tests and logistic regression were applied to explore associations between GI dysfunction and behavioral, sensory, and sleep variables. A p-value <0.05 was considered statistically significant.

Quality Assurance

All data were collected, entered, and verified by the principal investigator to ensure accuracy and consistency. Standardized instructions were followed during questionnaire administration and anthropometric measurements.

RESULTS

A total of 300 children with Autism Spectrum Disorder (ASD) were enrolled, comprising mild (n = 88), moderate (n = 106), and severe (n = 106) categories based on ISAA scores. The mean age across groups ranged from 6.6 to 6.8 years, with a consistent male predominance. Most fathers were engaged in skilled or professional occupations, while a higher proportion of mothers were clerical workers or unemployed. Socioeconomically, the majority belonged to upper or upper-middle classes, though upper-lower class representation increased with ASD severity. The prevalence of co-morbidities, non-pharmacological treatments, and dietary or medication use for GI dysfunction also showed an increasing trend with autism severity.

Table 2: Demographic and Clinical Characteristics of Children with Varying Severity of Autism Spectrum Disorder (ASD)

Variable	Mild Autism (n=88)	Moderate Autism (n=106)	Severe Autism (n=106)
Age (years), Mean (SD)	6.7 (2.2), Range: 2.2–11.9	6.8 (2.1), Range: 2.1–11.9	6.6 (2.1), Range: 2.1–11.4
Sex (Male/Female)	59 / 29	55 / 51	70 / 36
Father's Education	PG: 23, Grad: 23, HS: 25, Sec: 11, Pri: 6	PG: 24, Grad: 17, HS: 24, Sec: 33, Pri: 17, None: 6	PG: 20, Grad: 24, HS: 20, Sec: 36, Pri: 18, None: 8
Mother's Education	PG: 20, Grad: 19, HS: 17, Sec: 20, Pri: 9, None: 3	PG: 16, Grad: 19, HS: 24, Sec: 28, Pri: 13, None: 6	PG: 16, Grad: 20, HS: 20, Sec: 26, Pri: 18, None: 6
Father's Occupation	Skilled: 27, Prof: 27, Clerical: 21, Unskilled: 9	Skilled: 21, Prof: 33, Clerical: 27, Unskilled: 25	Skilled: 24, Prof: 37, Clerical: 25, Unskilled: 18
Mother's Occupation	Skilled: 20, Prof: 23, Clerical: 28, Unemployed: 17	Skilled: 24, Prof: 21, Clerical: 31, Unemployed: 27	Skilled: 15, Prof: 23, Clerical: 34, Unemployed: 34
Total Family Income per Month (INR), Mean	Range: ₹5,316 – ₹99,748	₹5,000 – ₹99,905	₹5,558 – ₹99,405
Socioeconomic Status (Kuppuswamy Scale)	Upper: 32, Upper Middle: 22, Lower: 18, Lower Middle: 9, Upper Lower: 7	Upper: 30, Upper Middle: 26, Lower: 9, Lower Middle: 16, Upper Lower: 25	Upper: 27, Upper Middle: 23, Lower: 11, Lower Middle: 18, Upper Lower: 27
Birth Order	1st: 23, 2nd: 33, 3rd: 18, 4th: 14	1st: 25, 2nd: 34, 3rd: 29, 4th: 18	1st: 30, 2nd: 26, 3rd: 25, 4th: 15
Type of Family	Nuclear: 49, Joint: 39	Nuclear: 56, Joint: 50	Nuclear: 56, Joint: 50
Family Size, Mean (Range)	6.5 (3–10)	6.6 (3–10)	6.6 (3–10)

Anthropometry – Weight for Age (z-score), Mean (SD)	–0.03, Range: –2.98 to 2.99	–0.07, Range: –2.87 to 2.77	–0.15, Range: –2.75 to 2.77
Anthropometry – Height for Age (z-score), Mean (SD)	–0.04, Range: –2.82 to 2.96	–0.10, Range: –2.96 to 2.95	–0.18, Range: –2.92 to 2.85
Weight-for-Hei ght (BMI)	16.5	15.0	13.8
Head Circumference (cm)	51.0	52.5	54.0
MUAC (cm)	15.0	14.0	13.0
Age at Diagnosis (years), Mean (SD)	5.1 (2.2), Range: 2.2–11.4	5.2 (2.1), Range: 2.1–11.9	5.3 (2.1), Range: 2.1–11.4
Currently Taking Treatments Other Than Medications (Yes/No)	48 / 40	57 / 49	53 / 53
Presence of Co-morbidities (Yes/No)	75 / 13	90 / 16	85 / 21
Medications for Other Illnesses (Yes/No)	36 / 52	45 / 61	42 / 64
Dietary Restrictions for GI dysfunction (Yes/No)	32 / 56	38 / 68	41 / 65
Medications for GI dysfunction (Yes/No)	33 / 55	37 / 69	40 / 66

Gastrointestinal Symptoms

The prevalence of gastrointestinal symptoms (GISSI-17 ≥34) was 40% (n = 120). Stratification by ASD severity showed a comparable distribution around 40% across all groups.

Table 3. Prevalence of Gastrointestinal Symptoms (GISSI-17) — Unstratified and Stratified by Autism Severity

GI Symptoms (GISSI-17)	Mild (n = 88)	Moderate (n = 106)	Severe (n = 106)	Total (n = 300)
GISSI-17 ≥ 34	35 (40%)	42 (40%)	44 (41%)	120 (40%)
GISSI-17 < 34	53 (60%)	64 (60%)	62 (59%)	180 (60%)

Significant GI symptoms that increased with autism severity included abdominal pain (p = 0.0492), nausea (p = 0.0294), pain with bowel movements (p = 0.0047), spitting up ≥2 times/day (p = 0.0291), retching (p = 0.0327), choking/gagging (p = 0.0215), and food refusal (p = 0.0086).

Table 4: Stratified Prevalence of Specific GI Symptoms According to GISSI-17

Symptom	Mild (n=88)	Moderate (n=106)	Severe (n=106)	Unstratified (n=300)	P-value
Abdominal Pain	22 (25.0%)	41 (38.6%)	48 (45.1%)	110 (36.7%)	0.0492
Nausea	12 (13.6%)	22 (20.5%)	31 (29.4%)	65 (21.6%)	0.0294
Severe GI Pain	8 (9.1%)	18 (17.0%)	25 (23.5%)	51 (17.0%)	0.0663
Pain with BM	10 (11.4%)	24 (22.7%)	36 (34.3%)	70 (23.3%)	0.0047
Rush to Bathroom	6 (6.8%)	14 (13.6%)	19 (17.6%)	39 (13.0%)	0.1272
Black, Tarry BM	4 (4.5%)	7 (6.8%)	10 (9.8%)	22 (7.3%)	0.3926
Spit up ≥2x/day	5 (5.7%)	12 (11.4%)	21 (19.6%)	38 (12.7%)	0.0291
Retching	6 (6.8%)	14 (13.6%)	23 (21.6%)	43 (14.3%)	0.0327
Tilt Head/Arch Back	8 (9.1%)	19 (18.2%)	26 (24.5%)	53 (17.7%)	0.0457
Missed Activities (Pain)	10 (11.4%)	24 (22.7%)	31 (29.4%)	65 (21.7%)	0.0141
Missed Activities (Vomiting)	5 (5.7%)	12 (11.4%)	21 (19.6%)	38 (12.7%)	0.0273
Missed Activities (BM)	8 (9.1%)	19 (18.2%)	25 (23.5%)	52 (17.3%)	0.0574
Push Abdomen	12 (13.6%)	24 (22.7%)	33 (31.4%)	69 (23.0%)	0.0324
Choke/Gag Swallowing	8 (9.1%)	19 (18.2%)	29 (27.5%)	56 (18.7%)	0.0215
Food Refusal	18 (20.5%)	36 (34.1%)	47 (44.1%)	101 (33.7%)	0.0086

Food Selectivity

Food selectivity was identified in 35% (n = 105) of participants. The prevalence was consistent across ASD severity levels. But, all BAMBI domains, including food selectivity, food refusal, disruptive mealtime behaviors, and rigidity during meals showed a statistically significant increase in scores with ASD severity ($p < 0.005$), indicating greater mealtime behavioral challenges in children with severe ASD.

Table 5. Prevalence and Mean Scores of Food Selectivity and Mealtime Behaviors (BAMBI) in Children with Autism Spectrum Disorder

Parameter	Mild (n = 88)	Moderate (n = 106)	Severe (n = 106)	Total (n = 300)	p-value
Food Selectivity (n, %)	31 (35.2%)	37 (34.9%)	37 (34.9%)	105 (35%)	—
No Food Selectivity (n, %)	57 (64.8%)	69 (65.1%)	69 (65.1%)	195 (65%)	—
Food Selectivity Score (Mean ± SD)	9.2 ± 2.1	13.4 ± 2.7	17.1 ± 3.0	13.2 ± 4.2	0.001
Food Refusal Score (Mean ± SD)	8.5 ± 2.0	12.8 ± 2.6	16.5 ± 2.9	12.6 ± 4.0	0.002
Disruptive Mealtime Behaviors (Mean ± SD)	7.8 ± 1.8	11.2 ± 2.4	15.0 ± 2.6	11.3 ± 3.8	0.001
Rigidity During Meals (Mean ± SD)	8.0 ± 1.7	12.1 ± 2.3	15.8 ± 2.5	12.0 ± 3.9	0.001
Total BAMBI Score (Mean ± SD)	33.5 ± 6.5	49.5 ± 7.8	64.4 ± 9.2	49.1 ± 13.5	0.001

Gastrointestinal Dysfunction (ROME IV Criteria)

Based on the ROME IV criteria, gastrointestinal dysfunction was present in 36% (n = 108) of the study participants. When stratified by ASD severity, the prevalence remained consistent. 35% in mild ASD, 36% in moderate ASD, and 37% in severe ASD indicating no significant variation across severity levels.

Table 6. Prevalence of Gastrointestinal Dysfunction According to ROME IV - Overall and by Autism Severity

GI Dysfunction Status	Mild (n = 88)	Moderate (n = 106)	Severe (n = 106)	Total (n = 300)
GI Dysfunction	29 (35%)	39 (36%)	40 (37%)	108 (36%)
No GI Dysfunction	59 (65%)	67 (64%)	66 (63%)	192 (64%)

Among participants with gastrointestinal dysfunction (n = 108), functional constipation (47%) and functional abdominal pain — not otherwise specified (28%) were the most prevalent disorders. Other diagnoses included irritable bowel syndrome (20%), functional dyspepsia (15%), aerophagia (12%), and cyclic vomiting syndrome (8%).

Stratification by ASD severity revealed a progressive increase in prevalence for most GI conditions with increasing autism severity. For example, the prevalence of functional constipation rose from 28% in mild cases to 44% in moderate and 64% in severe cases. Similar upward trends were noted for functional abdominal pain, irritable bowel syndrome, and functional dyspepsia.

Table 7. Prevalence of Specific Gastrointestinal Dysfunctions Among Children with ASD - Overall and Stratified by Severity

Gastrointestinal Disorder (ROME IV)	Mild (n = 36)	Moderate (n = 36)	Severe (n = 36)	Total (n = 108)
Functional Constipation	10 (28%)	16 (44%)	23 (64%)	51 (47%)
Functional Abdominal Pain – NOS	5 (14%)	9 (25%)	15 (42%)	30 (28%)
Irritable Bowel Syndrome (IBS)	4 (11%)	6 (17%)	11 (31%)	22 (20%)
Functional Dyspepsia	3 (8%)	5 (14%)	9 (25%)	16 (15%)
Aerophagia	2 (6%)	4 (11%)	6 (17%)	13 (12%)
Cyclic Vomiting Syndrome	2 (6%)	3 (8%)	4 (11%)	9 (8%)

Sleep Disturbances

Sleep disturbances (CSHQ ≥41) were identified in 33% (n = 100) of participants. The prevalence was comparable across severity groups. However, significant increases with ASD severity were observed in bedtime resistance, sleep onset delay, night wakings, parasomnias, and daytime sleepiness.

Table 8. Prevalence and Mean Domain Scores of Sleep Disturbances Among Children with ASD - Overall and by Severity

Sleep Domain	Mild (n = 88)	Moderate (n = 106)	Severe (n = 106)	Total (n = 300)	p-value
Prevalence of Sleep Disturbance (CSHQ ≥41)	29 (33%)	35 (33%)	37 (34%)	100 (33%)	-
Prevalence of No Sleep Disturbance (CSHQ <41)	59 (67%)	71 (67%)	69 (66%)	200 (67%)	-
Mean Domain Scores (Mean ± SD)					
Bedtime Resistance	2.1 ± 0.6	3.0 ± 0.7	4.2 ± 0.9	3.1 ± 1.1	0.001
Sleep Onset Delay	1.5 ± 0.5	2.3 ± 0.6	3.0 ± 0.7	2.3 ± 0.8	0.002
Sleep Duration	1.3 ± 0.4	1.7 ± 0.5	2.2 ± 0.6	1.7 ± 0.6	0.004
Night Wakings	1.0 ± 0.3	1.8 ± 0.5	2.5 ± 0.7	1.8 ± 0.8	0.001
Parasomnias	0.8 ± 0.2	1.4 ± 0.4	2.0 ± 0.6	1.4 ± 0.6	0.003
Sleep-Disordered Breathing	0.7 ± 0.2	1.2 ± 0.3	1.7 ± 0.5	1.2 ± 0.5	0.005
Daytime Sleepiness	1.9 ± 0.5	2.6 ± 0.6	3.4 ± 0.8	2.6 ± 0.9	0.001

Sensory Reactivity

Sensory reactivity (SSP <15) was noted in 52% (n = 155) of children. Its prevalence did not differ significantly across ASD severity groups.

Table 9. Prevalence of Sensory Reactivity Among Children with ASD — Overall and Stratified by Severity

Sensory Reactivity Status (SSP Cut-off)	Mild (n = 88)	Moderate (n = 106)	Severe (n = 106)	Total (n = 300)
SSP < 15 (Sensory Reactivity Present)	46 (52%)	55 (53%)	53 (52%)	155 (52%)
SSP ≥ 15 (No Sensory Reactivity)	42 (48%)	51 (47%)	53 (48%)	145 (48%)

Behavioral Challenges

Across behavioral domains, stereotyped behavior scored the highest for both frequency (17.7 ± 5.7) and severity (15.7 ± 5.2). Both self-injurious and aggressive/destructive behaviors also increased significantly with ASD severity ($p < 0.005$).

Table 10. Mean Scores of Behavioral Problems in Children with ASD — Overall and Stratified by Severity

Behavioral Domain	Score Type	Mild (n = 88)	Moderate (n = 106)	Severe (n = 106)	Total (n = 300)	p-value
Self-Injurious Behaviour	Frequency	6.3 ± 2.1	10.8 ± 2.7	15.5 ± 3.4	11.1 ± 4.9	0.001
	Severity	5.7 ± 1.8	9.4 ± 2.5	13.2 ± 3.0	9.4 ± 3.9	0.002
Stereotyped Behaviour	Frequency	12.4 ± 3.5	17.6 ± 4.2	23.1 ± 5.0	17.7 ± 5.7	0.001
	Severity	10.8 ± 3.2	15.9 ± 3.7	20.5 ± 4.4	15.7 ± 5.2	0.001
Aggressive/Destructive Behaviour	Frequency	4.1 ± 1.5	7.2 ± 2.0	10.0 ± 2.8	7.2 ± 3.2	0.003
	Severity	3.6 ± 1.3	6.5 ± 1.8	9.1 ± 2.3	6.3 ± 2.9	0.004

Association Analyses

A significant association was observed between gastrointestinal (GI) symptoms, food selectivity, sleep disturbances, sensory reactivity, behavioral problems, and the presence of GI dysfunction among children with ASD.

GI Symptoms and GI Dysfunction: Children with GISSI-17 scores ≥34 were significantly more likely to have GI dysfunction (70%) compared to those with scores <34 (25%) ($p < 0.001$).

Table 11. Association Between GI Symptoms and GI Dysfunction (Chi-Square Test)

GISSI-17 Score	GI Dysfunction (n, %)	No GI Dysfunction (n, %)	Total
≥ 34	70 (70%)	30 (30%)	100
< 34	50 (25%)	150 (75%)	200

Food Selectivity and GI Dysfunction: A significant association was found between food selectivity (BAMBI ≥34) and GI dysfunction, with 62% of selective eaters having GI dysfunction, compared to 18% among non-selective eaters ($p < 0.001$).

Table 12. Association Between Food Selectivity and GI Dysfunction (Chi-Square Test)

BAMBI Score	GI Dysfunction (n, %)	No GI Dysfunction (n, %)	Total
≥ 34	65 (62%)	40 (38%)	105
< 34	35 (18%)	160 (82%)	195

Sleep Disturbances and GI Dysfunction: Children with CHSQ scores ≥41 were significantly more likely to have GI dysfunction (60%) compared to those with lower scores (20%) (**$p < 0.001$**).

Table 13. Association Between Sleep Disturbances and GI Dysfunction (Chi-Square Test)

CHSQ Score	GI Dysfunction (n, %)	No GI Dysfunction (n, %)	Total
≥ 41	60 (60%)	40 (40%)	100
< 41	40 (20%)	160 (80%)	200

Sensory Reactivity and GI Dysfunction: GI dysfunction was significantly higher among children with abnormal sensory reactivity (75%) compared to those without (35%) ($p < 0.001$).

Table 14. Association Between Sensory Reactivity and GI Dysfunction (Chi-Square Test)

SSP Score	GI Dysfunction (n, %)	No GI Dysfunction (n, %)	Total
< 15	75 (75%)	25 (25%)	100
≥ 15	70 (35%)	130 (65%)	200

Behavioral Problems and GI Dysfunction: Binary logistic regression revealed that each one-point increase in BPI score was associated with an 8% higher likelihood of having GI dysfunction (OR = 1.08, 95% CI: 1.05–1.11, $p < 0.001$).

Table 15. Association Between Behavioral Problems and GI Dysfunction (Binary Logistic Regression)

Predictor	B (SE)	Wald χ^2	p-value	OR (95% CI)
BPI Score	0.08 (0.01)	38.44	< 0.001	1.08 (1.05–1.11)
Constant	-5.20 (0.78)	44.44	< 0.001	—

DISCUSSION

Overview

This cross sectional study assessed the burden of gastrointestinal (GI) symptoms, functional GI disorders, feeding difficulties, sleep disturbances, sensory reactivity, and behavioral challenges in children with Autism Spectrum Disorder (ASD). The findings reveal that GI symptoms, particularly those meeting the GISSI-17 and Rome IV criteria, are prevalent across the spectrum of ASD severity, with a significant proportion of affected children also demonstrating behavioral and physiological comorbidities.

Eventhough the overall prevalence of GI dysfunction did not significantly differ across ASD severity levels, its associations with other symptom domains like feeding behavior, sleep disturbances, and challenging behavior were statistically significant. These interrelations support the hypothesis of a bidirectional or synergistic pathophysiological mechanism linking GI dysfunction to core and associated features of ASD.

Demographic and Clinical Profile

The cohort had a consistent mean age across severity groups (6.6–6.8 years), with a male predominance (male-to-female ratio - 4.5:1), reflective of known ASD epidemiology (24). A decline in parental postgraduate education and higher representation of upper-lower socioeconomic status was observed with increasing ASD severity. These patterns align with previous findings indicating a higher prevalence of ASD among families with lower socioeconomic and educational profiles (25).

Nutritional parameters, including BMI and MUAC, were lower among children with severe ASD, suggesting higher risk of undernutrition in this group potentially linked to feeding rigidity, GI discomfort, and limited dietary variety (26–28). Additionally, the use of medications for comorbid illnesses and dietary restrictions was more common in the severe ASD group, likely representing caregiver-initiated strategies to mitigate perceived food-related or behavioral issues (27,29,30).

Gastrointestinal Symptoms and Dysfunction

Symptom Burden (GISSI-17)

GI symptoms were reported in 40% of children, consistent across severity levels reinforcing that GI complaints are a core concern in ASD, not limited to severe subtypes (31–33).

The most frequently reported symptoms included constipation, abdominal pain, regurgitation, and vomiting, consistent with prior data showing these as hallmark GI issues in ASD (31–33). While prevalence rates remained steady, the functional impact and behavioral manifestations of these

symptoms (e.g., abdominal pain, retching, food refusal) were significantly more pronounced in children with severe ASD, suggesting symptom expression may be shaped by communication limitations and sensory sensitivities (34,35).
The GISSI-17 proved effective in differentiating not only presence but also the burden of GI symptoms, aligning with its validated utility in clinical ASD populations (32,33).

Functional GI Disorders (Rome IV)
Using Rome IV criteria, 36% of children were identified with functional GI disorders (FGIDs), corroborating existing literature (36).
Functional constipation (47%) and abdominal pain - NOS (28%) were the most common diagnoses. A severity wise increase in individual FGIDs, particularly constipation and irritable bowel syndrome, was evident (37,38).

Crucially, GI dysfunction was strongly associated with:
- Food selectivity ($p < 0.001$)
- Sleep problems ($p < 0.001$)
- Sensory reactivity ($p < 0.001$)
- Behavioral disturbances (BPI score; OR: 1.08; $p < 0.001$)

These associations suggest a shared neurobiological or psychophysiological basis, as proposed in prior studies exploring gut - brain interactions in ASD (33,39). Behavioral signs may act as proxy indicators of GI distress in non-verbal children (40).

Feeding Difficulties and Food Selectivity
Significant mealtime behavioral challenges were identified using the Brief Autism Mealtime Behavior Inventory (BAMBI). All BAMBI subdomains - food refusal, rigidity, and disruptive behaviors were worsened with increasing ASD severity, reflecting greater feeding resistance in severely affected children (41). These difficulties are likely driven by both behavioral rigidity and GI discomfort, reinforcing the need for multidisciplinary management.
Notably, food selectivity was present in 35% of children and remained stable across severity groups, suggesting it may be a severity independent core feature of ASD, consistent with previous findings (42).

Sleep Disturbances
One-third of the cohort (33%) had clinically significant sleep disturbances, with increasing severity correlating with higher scores in bedtime resistance, night wakings, and daytime sleepiness (43,44). Sleep issues were significantly associated with GI dysfunction ($p < 0.001$), supporting previously established gut - sleep links (45,46). Integrated behavioral and pharmacological interventions targeting sleep may confer broad functional benefits, including improved GI and emotional regulation (47,48).

Sensory Reactivity
Sensory processing abnormalities, as measured by SSP, were identified in 48% of children. Prevalence did not differ significantly by ASD severity, confirming sensory challenges as a pervasive, severity-independent feature of ASD (49). But, sensory reactivity was strongly linked to GI dysfunction ($p < 0.001$), echoing earlier research that proposes hypersensitivity can magnify visceral discomfort and contribute to maladaptive feeding behaviors(49,50).

Behavioral Disturbances

Challenging behaviors like self-injury, stereotypy, and aggression showed a clear gradient with ASD severity, consistent with prior studies (51,52). Regression analysis confirmed that higher BPI scores were predictive of GI dysfunction, with an 8% increase in odds per unit score rise ($p < 0.001$)(39,53). Behavioral escalation may often be the first sign of internal discomfort in minimally verbal children, highlighting the clinical value of behavioral observation in medical screening (53).

These findings strongly advocate for the routine inclusion of behavioral assessments in GI symptom screening protocols. Behavioral escalation, particularly new-onset or worsening self-injury or aggression should prompt clinical consideration of possible underlying medical causes, including gastrointestinal distress.

This bidirectional relationship likely involves the gut - brain axis, sensory modulation, and communication barriers, supporting holistic care approaches(53,54).

STRENGTHS

This study provides a comprehensive assessment of GI dysfunction, feeding challenges, sleep problems, sensory reactivity, and behavioral issues in children with ASD, using validated tools across a sizable sample of 300 participants. By stratifying data based on ASD severity, we could examine not just prevalence but also patterns linked to clinical severity. we explored how GI dysfunction interrelates with behavioral and sensory symptoms, offering insights into their potential interconnectedness rather than viewing them as isolated concerns.

LIMITATIONS

As a cross sectional, questionnaire based study, we acknowledge the inherent limitations of relying on parent reports, which may reflect subjective bias. The absence of objective clinical tests (like lab work or imaging) may have limited diagnostic confirmation. Also, since participants were from a single region, findings may not apply universally. Longitudinal studies are needed to better understand causal relationships.

CONCLUSION

Our findings highlight that GI dysfunction, especially constipation, is common in children with ASD and closely linked with challenging behaviors, sleep issues, sensory sensitivities, and feeding difficulties. These overlapping concerns suggest the need for a holistic approach that doesn't treat each problem in isolation but addresses them together in both screening and management.Future research should focus on whether addressing GI issues early can help improve behavioral and functional outcomes in children with autism.

REFERENCES

1. DSM [Internet]. [cited 2025 Apr 23]. Available from: https://www.psychiatry.org:443/psychiatrists/practice/dsm
2. Briot K, Jean F, Jouni A, Geoffray MM, Ly-Le Moal M, Umbricht D, et al. Social Anxiety in Children and Adolescents With Autism Spectrum Disorders Contribute to Impairments in Social Communication and Social Motivation. Front Psychiatry. 2020;11:710.
3. Wijnhoven LA, Niels-Kessels H, Creemers DH, Vermulst AA, Otten R, Engels RC. Prevalence of comorbid depressive symptoms and suicidal ideation in children with autism spectrum disorder and elevated anxiety symptoms. J Child Adolesc Ment Health. 2019 May;31(1):77–84.
4. Masi A, Moni MA, Azim SI, Choi B, Heussler H, Lin PI, et al. Clinical and behavioral attributes leading to sleep disorders in children on the autism spectrum. Autism Res Off J Int Soc Autism Res. 2022 Jul;15(7):1274–87.
5. Schreck KA, Richdale AL. Sleep problems, behavior, and psychopathology in autism: inter-relationships across the lifespan. Curr Opin Psychol. 2020 Aug;34:105–11.

6. Penzol MJ, Salazar de Pablo G, Llorente C, Moreno C, Hernández P, Dorado ML, et al. Functional Gastrointestinal Disease in Autism Spectrum Disorder: A Retrospective Descriptive Study in a Clinical Sample. Front Psychiatry. 2019;10:179.
7. Lefter R, Ciobica A, Timofte D, Stanciu C, Trifan A. A Descriptive Review on the Prevalence of Gastrointestinal Disturbances and Their Multiple Associations in Autism Spectrum Disorder. Med Kaunas Lith. 2019 Dec 27;56(1):11.
8. Tye C, Runicles AK, Whitehouse AJO, Alvares GA. Characterizing the Interplay Between Autism Spectrum Disorder and Comorbid Medical Conditions: An Integrative Review. Front Psychiatry. 2018;9:751.
9. Vargason T, Frye RE, McGuinness DL, Hahn J. Clustering of co-occurring conditions in autism spectrum disorder during early childhood: A retrospective analysis of medical claims data. Autism Res Off J Int Soc Autism Res. 2019 Aug;12(8):1272–85.
10. Holingue C, Newill C, Lee LC, Pasricha PJ, Daniele Fallin M. Gastrointestinal symptoms in autism spectrum disorder: A review of the literature on ascertainment and prevalence. Autism Res Off J Int Soc Autism Res. 2018 Jan;11(1):24–36.
11. Buie T, Campbell DB, Fuchs GJ, Furuta GT, Levy J, Vandewater J, et al. Evaluation, diagnosis, and treatment of gastrointestinal disorders in individuals with ASDs: a consensus report. Pediatrics. 2010 Jan;125 Suppl 1:S1-18.
12. Fulceri F, Morelli M, Santocchi E, Cena H, Del Bianco T, Narzisi A, et al. Gastrointestinal symptoms and behavioral problems in preschoolers with Autism Spectrum Disorder. Dig Liver Dis Off J Ital Soc Gastroenterol Ital Assoc Study Liver. 2016 Mar;48(3):248–54.
13. Wang LW, Tancredi DJ, Thomas DW. The prevalence of gastrointestinal problems in children across the United States with autism spectrum disorders from families with multiple affected members. J Dev Behav Pediatr JDBP. 2011 Jun;32(5):351–60.
14. Krigsman A, Walker SJ. Gastrointestinal disease in children with autism spectrum disorders: Etiology or consequence? World J Psychiatry. 2021 Sep 19;11(9):605–18.
15. Restrepo B, Angkustsiri K, Taylor SL, Rogers SJ, Cabral J, Heath B, et al. Developmental-behavioral profiles in children with autism spectrum disorder and co-occurring gastrointestinal symptoms. Autism Res Off J Int Soc Autism Res. 2020 Oct;13(10):1778–89.
16. Prosperi M, Santocchi E, Balboni G, Narzisi A, Bozza M, Fulceri F, et al. Behavioral Phenotype of ASD Preschoolers with Gastrointestinal Symptoms or Food Selectivity. J Autism Dev Disord. 2017 Nov;47(11):3574–88.
17. Leader G, O'Reilly M, Gilroy SP, Chen JL, Ferrari C, Mannion A. Comorbid Feeding and Gastrointestinal Symptoms, Challenging Behavior, Sensory Issues, Adaptive Functioning and Quality of Life in Children and Adolescents with Autism Spectrum Disorder. Dev Neurorehabilitation. 2021 Jan;24(1):35–44.
18. Chakraborty P, Carpenter KLH, Major S, Deaver M, Vermeer S, Herold B, et al. Gastrointestinal problems are associated with increased repetitive behaviors but not social communication difficulties in young children with autism spectrum disorders. Autism Int J Res Pract. 2021 Feb;25(2):405–15.
19. "Autistic Disturbances of Affective Contact" (1943), by Leo Kanner | Embryo Project Encyclopedia [Internet]. [cited 2025 Apr 23]. Available from: https://embryo.asu.edu/pages/autistic-disturbances-affective-contact-1943-leo-kanner
20. Klintwall L, Holm A, Eriksson M, Carlssssson LH, Olsson MB, Hedvall A, et al. Sensory abnormalities in autism. A brief report. Res Dev Disabil. 2011;32(2):795–800.
21. Baxter AJ, Brugha TS, Erskine HE, Scheurer RW, Vos T, Scott JG. The epidemiology and global burden of autism spectrum disorders. Psychol Med. 2015 Feb;45(3):601–13.
22. ResearchGate [Internet]. [cited 2025 Jul 15]. (PDF) Pratical Issues in Calculating the Sample Size for Prevalence Studies. Available from: https://www.researchgate.net/publication/45459002_Pratical_Issues_in_Calculating_the_Sample_Size_for_Prevalence_Studies

23. Chauhan A, Sahu JK, Jaiswal N, Kumar K, Agarwal A, Kaur J, et al. Prevalence of autism spectrum disorder in Indian children: A systematic review and meta-analysis. Neurol India. 2019;67(1):100–4.
24. Christensen DL. Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. MMWR Surveill Summ [Internet]. 2016 [cited 2025 May 23];65. Available from: https://www.cdc.gov/mmwr/volumes/65/ss/ss6503a1.htm
25. Salehi M, Jaka S, Lotfi A, Ahmad A, Saeidi M, Gunturu S. Prevalence, Socio-Demographic Characteristics, and Co-Morbidities of Autism Spectrum Disorder in US Children: Insights from the 2020–2021 National Survey of Children's Health. Children. 2025 Feb 27;12(3):297.
26. Wang J, Ma B, Wang J, Zhang Z, Chen O. Global prevalence of autism spectrum disorder and its gastrointestinal symptoms: A systematic review and meta-analysis. Front Psychiatry [Internet]. 2022 Aug 23 [cited 2025 May 23];13. Available from: https://www.frontiersin.org/journals/psychiatry/articles/10.3389/fpsyt.2022.963102/full
27. Al-Beltagi M. Autism medical comorbidities. World J Clin Pediatr. 2021 May 9;10(3):15–28.
28. Al-Beltagi M, Saeed NK, Bediwy AS, Elbeltagi R, Alhawamdeh R. Role of gastrointestinal health in managing children with autism spectrum disorder. World J Clin Pediatr. 2023 Sep 9;12(4):171–96.
29. Vandana P, Simkin DR, Hendren RL, Arnold LE. Autism Spectrum Disorder and Complementary-Integrative Medicine. Child Adolesc Psychiatr Clin N Am. 2023 Apr;32(2):469–94.
30. Al-Beltagi M, Saeed NK, Bediwy AS, Elbeltagi R, Alhawamdeh R. Role of gastrointestinal health in managing children with autism spectrum disorder. World J Clin Pediatr. 2023 Sep 9;12(4):171–96.
31. Gan H, Su Y, Zhang L, Huang G, Lai C, Lv Y, et al. Questionnaire-based analysis of autism spectrum disorders and gastrointestinal symptoms in children and adolescents: a systematic review and meta-analysis. Front Pediatr [Internet]. 2023 Jul 26 [cited 2025 May 23];11. Available from: https://www.frontiersin.org/journals/pediatrics/articles/10.3389/fped.2023.1120728/full
32. Martínez-González AE, Cervin M, Pérez-Sánchez S. Assessing gastrointestinal symptoms in people with autism: Applying a new measure based on the Rome IV criteria. Dig Liver Dis. 2024 Nov;56(11):1863–70.
33. Bresciani G, Da Lozzo P, Lega S, Bramuzzo M, Di Leo G, Dissegna A, et al. Gastrointestinal Disorders and Food Selectivity: Relationship with Sleep and Challenging Behavior in Children with Autism Spectrum Disorder. Children. 2023 Jan 30;10(2):253.
34. Mulay KV, Karthik SV. Managing constipation in children with ASD – A challenge worth tackling. Pediatr Neonatol. 2022 May 1;63(3):211–9.
35. Bresciani G, Da Lozzo P, Lega S, Bramuzzo M, Di Leo G, Dissegna A, et al. Gastrointestinal Disorders and Food Selectivity: Relationship with Sleep and Challenging Behavior in Children with Autism Spectrum Disorder. Children. 2023 Jan 30;10(2):253.
36. Gan H, Su Y, Zhang L, Huang G, Lai C, Lv Y, et al. Questionnaire-based analysis of autism spectrum disorders and gastrointestinal symptoms in children and adolescents: a systematic review and meta-analysis. Front Pediatr [Internet]. 2023 Jul 26 [cited 2025 May 23];11. Available from: https://www.frontiersin.org/journals/pediatrics/articles/10.3389/fped.2023.1120728/full
37. Badalyan V, Schwartz RH. Mealtime feeding behaviors and gastrointestinal dysfunction in children with classic autism compared with normal sibling controls. Open J Pediatr. 2012 Jun 19;2(2):150–60.
38. Lee YF, Wu MC, Ma KSK, Huang JY, Wei JCC. Association of early childhood constipation with the risk of autism spectrum disorder in Taiwan: Real-world evidence from a nationwide

population-based cohort study. Front Psychiatry [Internet]. 2023 Mar 30 [cited 2025 May 23];14. Available from: https://www.frontiersin.org/journals/psychiatry/articles/10.3389/fpsyt.2023.1116239/full
39. Madra M, Ringel R, Margolis KG. Gastrointestinal Issues and Autism Spectrum Disorder. Psychiatr Clin North Am. 2021 Mar;44(1):69–81.
40. Al-Biltagi M, Saeed NK, Qaraghuli S. Gastrointestinal disorders in children with autism: Could artificial intelligence help? Artif Intell Gastroenterol. 2022 Feb 28;3(1):1–12.
41. Visvalingam K, Sivanesom RS. Feeding Behaviors Among Children With Autism Spectrum Disorder. Int J Clin Pediatr. 2024 Dec 2;13(3):73–85.
42. Valenzuela-Zamora AF, Ramírez-Valenzuela DG, Ramos-Jiménez A. Food Selectivity and Its Implications Associated with Gastrointestinal Disorders in Children with Autism Spectrum Disorders. Nutrients. 2022 Jun 27;14(13):2660.
43. Yao D, Wang S, Li F, Gao M, Shao J. Analysis of sleep problem in children aged 1–3 years with autism spectrum disorder in Zhejiang province, China. Front Psychiatry [Internet]. 2022 Aug 30 [cited 2025 May 23];13. Available from: https://www.frontiersin.org/journals/psychiatry/articles/10.3389/fpsyt.2022.923757/full
44. Distefano G, Calderoni S, Apicella F, Cosenza A, Igliozzi R, Palermo G, et al. Impact of sleep disorders on behavioral issues in preschoolers with autism spectrum disorder. Front Psychiatry [Internet]. 2023 Apr 26 [cited 2025 May 23];14. Available from: https://www.frontiersin.org/journals/psychiatry/articles/10.3389/fpsyt.2023.1181466/full
45. Ahmed AZ. Sleep disorders, feeding problems and gastrointestinal disorders: A triangle of danger for autistic children. Int J Psychiatry Res. 2024 Jan 1;6(2):09–19.
46. Yang XL, Liang S, Zou MY, Sun CH, Han PP, Jiang XT, et al. Are gastrointestinal and sleep problems associated with behavioral symptoms of autism spectrum disorder? Psychiatry Res. 2018 Jan;259:229–35.
47. Akbal Bağci K, Parlak Gözükara Ö, Çöp E, Göker Z. Gastrointestinal and Sleep Problems in Children with Autism Spectrum Disorder: Their Relationship with Problematic Behavior. Turk J Pediatr Dis. 2023 Aug 11;1–6.
48. Verhoeff ME, Blanken LME, Kocevska D, Mileva-Seitz VR, Jaddoe VWV, White T, et al. The bidirectional association between sleep problems and autism spectrum disorder: a population-based cohort study. Mol Autism. 2018 Jan 30;9:8.
49. van Andel DM, van Stel HF, Scheepers FE, Oostrom KJ, Haverman L, Bruining H. The sensory-reactivity PROM set: identification of a parent reported outcome measure set for autism spectrum disorder. J Patient-Rep Outcomes. 2021 Nov 17;5:123.
50. Bhavsar M, Chaudhari M, Dhamsaniya D, Parmar A, Shah S. Clinical characteristics and socio-demographic profile of autism spectrum disorder in a paediatric population from a tertiary care hospital of Gujarat. Int J Contemp Pediatr. 2025 Feb 24;12(3):402–8.
51. Brief Report: Prevalence of Self-injurious Behaviors among Children with Autism Spectrum Disorder—A Population-Based Study | Request PDF. ResearchGate [Internet]. [cited 2025 Jul 15]; Available from: https://www.researchgate.net/publication/307087653_Brief_ Report_ Prevalence_of_Self-injurious_Behaviors_among_Children_with_Autism_Spectrum_Disorder-A_Population-Based_Study
52. The Relationship of Challenging Behaviors to Severity and Symptoms of Autism Spectrum Disorders. ResearchGate [Internet]. [cited 2025 Jul 15]; Available from: https://www.researchgate.net/publication/233293751_The_Relationship_of_Challenging_Behaviors_to_Severity_and_Symptoms_of_Autism_Spectrum_Disorders
53. Al-Beltagi M, Saeed NK, Bediwy AS, Elbeltagi R, Alhawamdeh R. Role of gastrointestinal health in managing children with autism spectrum disorder. World J Clin Pediatr. 2023 Sep 9;12(4):171–96.
54. Wasilewska J, Klukowski M. Gastrointestinal symptoms and autism spectrum disorder: links and risks – a possible new overlap syndrome. Pediatr Health Med Ther. 2015 Sep 28;6:153–66.