Supplement S3: Behavioral and Neurodevelopmental

1 Behavioral and/or Neurodevelopmental Comorbidity

1.1 Cognitive and Learning (Intellectual) Disorders

Cognitive Disorders

Table 1: Prevalence of cognitive disorders in those with ASD.

Source	Sample	Prevalence	Other Notes
Hand et al. (2020) [14]	n=4685 (ASD), n=46850 (non-ASD); Age: ≥65; Medicare; 2016-17	Cognitive disorder: 25.2% (ASD), 4.9% (non-ASD)	aOR: 8.4(7.7-9.1)
Longo et al. (2024) [28]	n=30258 (ASD), n=60516 (non-ASD); Age: 18-64; IBM Market Scan Commercial Claims and Encounters Database; 2019-20	Cognitive disorder: 1.5% (ASD), 0.3% (non-ASD)	aOR: 3.9 (95% CI: 3.3, 4.7)

Intellectual Disability

Table 2: Prevalence of intellectual disabilities in those with ASD, table 1.

Source	Sample	Prevalence	Other Notes
Schendel et al. (2016) [42]	n=20492 (ASD), 1892412 (non-ASD); Age: >1.5; Danish Civil Registration Service and the Danish Medical Birth Register; born 1980-2010	Mental retardation: 16.0% (ASD), 0.4% (non-ASD)	
Houghton et al. (2017) [16]	n=46943 (ASD, commercial), Truven Health MarketScan Commercial Database, 2014; n=46696 (ASD, Medicaid), Truven Health MarketScan Multi-State Medicaid Database; Age: >3	5.03% (commercial), 23.36% (medicaid)	
Kurzius-Spencer et al. (2018) [25]	ADDM (2006, 2008, 2010 - 14 study sites). 8 yr old.	ASD and ID: 35.1%, ASD only: 64.9%	
Rydzewska et al. (2018) [39]	n=6649 (ASD), n=3739935 (non-ASD); Age: ≥25; Scotland Census data; 2011	29.4% (ASD), 0.4% (non-ASD)	
Bishop-Fitzpatrick et al. (2018) [4]	n=91 (ASD), n=6186 (sex, birth year matched controls); Age: 0-89; EHR from Marshfield clinic - decedents - Wisconsin	Intellectual disability: 75.8% (ASD), 0% (non-ASD)	p:<0.001
Bowden et al. (2020) [6]	n=8955 (ASD), n=1551342 (non-ASD); Age: 0-24; IDI database, New Zealand	Intellectual disability: 29.9% (ASD), 0.4% (non-ASD)	aOR: 61.9 (95% CI: 59.2-64.2) - standardized for age, sex, ethnicity, deprivation, and urban/rural

Table 3: Prevalence of intellectual disabilities in those with ASD, table 2.

Source	Sample	Prevalence	Other Notes
Bougeard et al. (2021) [5]	Review: N=13	ID, Range: 0% - 91.70%	
Chien et al. (2021) [9]	n=3837 (ASD), n=38370 (non-ASD); Children; Taiwan's claims database; 2000, 2005, 2010	Mental retardation: 27.5% (ASD), 1.3% (non-ASD)	
Rødgaard et al. (2021) [40]	n=11,914 (ASD, men), n=4212 (ASD, women); Age ≤16; Danish National Patient Registry	Intellectual disability: 17% (men with ASD), 17% (women with ASD)	
Angell et al. (2021) [2]	n=18355 (ASD, girls), n=65145 (ASD, boys); Age: 1-21; healthcare claims data; integrates ICD-9 and ICD-10 codes	Intellectual disability: 15.11% (ASD, girls), 10.74% (ASD, boys)	aOR: 1.49 (95% CI: 1.42-1.56), p:<0.001 - adjusted for age, race, ethnicity, urbanicity, and insurance
Huang et al. (2021) [18]	n=6599 (ASD), n=26396 (non-ASD); controls age, sex, date matched 1:4; All ages, mean: 5.1 (ASD), 5.8 (non-ASD); Taiwan National Health Insurance Research Database; ICD-9; 2000-15	Intellectual disability: 22.2% (ASD), 0.9% (non-ASD)	p: <0.01
Mutluer et al. (2022) [35]	Review, N=19; population and EHR studies (age 6-18)	Pooled prevalence: 22.9%	
Schott et al. (2022) [43]	n=166,952 (ASD), n=500,856 (non-ASD); Adults; Medicaid; 2008–12	23.53% (ASD), 26.77% (non-ASD)	
Hughes et al. (2023) [19]	n=1846 (ASD); ADDM Network (5 sites, USA); 2018	32% (before age 8), 36.6% (9-16)	
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=27 [N=11 (clinical studies from community samples), N=16 (population/registry based)], n=162,997	Pooled prevalence: 33%, Range: 26% - 41%	

Table 4: Prevalence of intellectual disabilities in those with ASD, table 3.

Source	Sample	Prevalence	Other Notes
Rim et al. (2023) [38]	n=381 (ASD), n=6179 (non-ASD); Age: 0-19; National Health Insurance System National Sample Cohort; South Korea; 2002–13	21.89% (ASD), 0.29% (non-ASD)	aOR: 78.9 (64.45,96.6)
Semovski et al. (2023) [44]	n=2020 (ASD); Age: 12-18; records + interviews; Canada	Intellectual disability: 24.6% (ASD)	
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18; 1999-2019	Intellectual disability: 21.7% (ASD), 2% (non-ASD, estimated)	p: <0.05
Hsu et al. (2024) [17]	n=22698 (ASD), [n=19191 (male), n=3507 (female)]; Age: 2-19; Taiwan's National Health Insurance Research Database; 2001-11; ICD-9	Intelligence disability: 26.9% (ASD, total); 24.8% (ASD, male), 38.4% (ASD, female)	RR: 0.54 (95% CI: 0.50-0.58) [Male vs female (ref)] - adjusted for age, income, residence, and parental psychiatric disorders. RR: 0.34 (95% CI: 0.19-0.61) [Parental psychiatric disorders - Male vs female (ref)] - adjusted for age, income, residence
Salehi et al. (2025) [41]	n=2568 (ASD); Age: 3-17; The National Survey of Children's Health; USA; 2020-21	16.1%	OR: 1.5, p = 0.001 [Female vs male]
Lopez-Arvizu et al. (2025) [29]	n=41230 (ASD, ID, or both), n=29001 (ASD), n=27054 (ID); Age: 5-24; Medicaid (6+ months, Midwestern states); 2010-20	Intellectual disability (any): 51.1% (ASD), 100% (ID), 65.6% (combined); Mild: 4.3% (ASD), 7.9% (ID), 5.2% (combined); Moderate: 2.0% (ASD), 7.3% (ID), 4.8% (combined); Severe: 0.8% (ASD), 2.5% (ID), 1.6% (combined); Profound: 0.2% (ASD), 0.9% (ID), 0.6% (combined)	

Developmental Delay/Disability

Table 5: Prevalence of developmental disabilities in those with ASD, table 1.

Source	Sample	Prevalence	Other Notes
Vohra et al. (2017) [48]	n=1772 (ASD), n=5316 (non-ASD); Age: 22-64; three state Medicaid Analytic eXtract; 2000-08	Developmental disorders: 69.5% (ASD), 5.1% (non-ASD)	aOR (95% CI): 44.60 (37.9, 52.4), p:<0.001
Soke et al. (2018) [46]	n=783 (ASD, age: 4), n=1091 (ASD, age; 8), ADDMN - 5 sites (Arizona, Missouri, New Jersey, Utah, and Wisconsin), 2010 survey, 4 and 8 year olds	Developmental Disability - cognitive: 16.73% (ASD, age: 4), 14.57% (ASD, age: 8)	Adjusted prevalence, 95% CI: 0.83 (0.67, 1.05) [8 vs 4 years] - adjusted for sex, ethnicity, maternal education, location
Soke et al. (2018) [46]	n=783 (ASD, age: 4), n=1091 (ASD, age; 8), ADDMN - 5 sites (Arizona, Missouri, New Jersey, Utah, and Wisconsin), 2010	Developmental disability - adaptive: 20.31% (ASD, age: 4), 20.81% (ASD, age: 8)	Adjusted prevalence, 95% CI: 1.13 (0.96, 1.36) [8 vs 4 years] - adjusted for sex, ethnicity, maternal education, location
Dizitzer et al. (2020) [13]	n=459 (ASD), n=2285 (non-ASD); Children, southern Israel, Negev Autism Center database, born 2009-16, controls age, sex, ethnicity matched	Developmental disorder: 12.9% (ASD), 1% (non-ASD)	OR: 14.51 (95% CI: 8.86-23.76), p:<0.001
Angell et al. (2021) [2]	n=18355 (ASD, girls), n=65145 (ASD, boys); Age: 1-21; healthcare claims data; integrates ICD-9 and ICD-10 codes	Developmental disabilities: 78.27% (ASD, girls), 76.66% (ASD, boys)	aOR: 1.16 (95% CI: 1.11-1.22), p:<0.001 - adjusted for age, race, ethnicity, urbanicity, and insurance
Jadav and Bal (2022) [21]	n=4657 (ASD); Adults; online survey, SPARK; 2022	Any developmental disorder: 30.3%	

Table 6: Prevalence of developmental disabilities in those with ASD, table 2.

Source	Sample	Prevalence	Other Notes
Shoaib et al. (2022) [45]	n=29694 (ASD, medicaid), IBM Marketscan Multi-State Medicaid Database; n=6719 (ASD, Optum), Optum De-Identified Clinformatics Data Mart Database, Date of Death; US; 2015-16	Developmental delay: 13.6% (Optum), 14.91% (Medicaid)	
Salehi et al. (2025) [41]	n=2568 (ASD); Age: 3-17; The National Survey of Children's Health; USA; 2020-21	Developmental delay: 64.0%	
Jadav and Bal (2022) [21]	n=4657 (ASD); Adults; online survey, SPARK; 2022	Intellectual disability, cognitive impairment, global developmental delay, or borderline intellectual functioning: 6.1%	
Davignon, et al. (2018) [11]	n=4123 (ASD), n=20615 (non-ASD, non-ADHD); Age: 14-25; Kaiser Permanente Northern California, 2013-15	Global Developmental Delay: 1.9% (ASD), 0.05% (non-ASD)	aOR (95% CI): 42.81 (27.56-66.50)

Table 7: Prevalence of developmental disabilities in those with ASD, table 3.

Source	Sample	Prevalence	Other Notes
Davignon, et al. (2018) [11]	n=4123 (ASD), n=20615 (non-ASD, non-ADHD); Age: 14-25; Kaiser Permanente Northern California, 2013-15	Learning disorder: 0.6% (ASD), 0.04% (non-ASD)	aOR (95% CI): 16.16 (7.45-35.03)
Bhat et al. (2020) [3]	n=11814 (ASD); SPARK; Children; DCD questionnaire	Learning disability: 17.9% (diagnosed)	
Chien et al. (2021) [9]	n=3837 (ASD), n=38370 (non-ASD); Children; Taiwan's claims database; 2000, 2005, 2010	Learning disorder: 61.0% (ASD), 6.0% (non-ASD)	
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=1, n=122	Specific learning disorder: Pooled prevalence: 13%, Range: 8% - 20%	
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at time of registration; 1999-2019	Learning disability: 23.5% (ASD), 4% (non-ASD, estimatedly)	p: <0.05
Semovski et al. (2023) [44]	n=2020 (ASD); Age: 12-18; records + interviews; Canada	Learning or communication disorder: 37.3% (ASD)	

1.2 Disorders of Attentional Controls

1.2.1 ADD/ADHD

Table 8: Prevalence of ADHD in those with ASD, table 1.

Source	Sample	Prevalence	Other Notes
Croen et al. (2015) [10]	n=1507 (ASD), n=15070 (age, sex matches controls); Adults; Kaiser Permanente Northern California; 2008-12	ADD: 11.08% (ASD), 1.95% (non-ASD)	Chi-square p value: <0.0001
Schendel et al. (2016) [42]	n=20492 (ASD), 1892412 (non-ASD); Age: >1.5; Danish Civil Registration Service and the Danish Medical Birth Register; born 1980-2010	ADHD: 27.6% (ASD), 1.5% (non-ASD)	
Vohra et al. (2017) [48]	n=1772 (ASD), n=5316 (non-ASD); Age: 22-64; three state Medicaid Analytic eXtract; 2000-08	ADHD: 8.2% (ASD), 0.7% (non-ASD)	aOR (95% CI): 12.89 (8.94, 18.5), p:<0.001
Houghton et al. (2017) [16]	n=46943 (ASD, commercial), Truven Health MarketScan Commercial Database, 2014; n=46696 (ASD, Medicaid), Truven Health MarketScan Multi-State Medicaid Database; Age: >3	ADHD: 37.82% (commercial), 40.49% (medicaid)	
Soke et al. (2018) [46]	n=783 (ASD, age: 4), n=1091 (ASD, age; 8), ADDMN - 5 sites (Arizona, Missouri, New Jersey, Utah, and Wisconsin), 2010	ADHD: 5.49% (ASD, age: 4), 26.05% (ASD, age: 8)	Adjusted prevalence, 95% CI: 4.78 (3.40, 6.73) [8 vs 4 years] - adjusted for sex, ethnicity, maternal education, location
Lai, et al. (2019) [26]	Meta-analysis, N=96	28%	
Margari et al. (2019) [30]	n=100 (ASD, male), n=59 (ASD, female); Children and adolescents, mean: 9.91 (ASD, male), mean: 10.97 (ASD, female); Child and Adolescent Neuropsychiatry Unit; 2016-18	ADHD: 32% (ASD, male), 42.7% (ASD, female)	p: 0.156
Mosner et al. (2019) [34]	n=67 (ASD); Age: 8-25; UNC Autism Research Registry; MINI-KID-P assessment and caregiver report	Any ADHD: 71.4% (MINI-KID-P), 34.3% (caregiver)	
Hossain et al. (2020) [15]	Umbrella Review, N=3	ADHD; 25.7% - 65%	

Table 9: Prevalence of ADHD in those with ASD, table 2.

Source	Sample	Prevalence	Other Notes
Hand et al. (2020) [14]	n=4685 (ASD), n=46850 (non-ASD); Age: ≥65; Medicare; 2016-17	Attention deficit disorders: 2.5% (ASD), 0.1% (non-ASD)	aOR: 22.4 (16.2-31.0)
Bhat et al. (2020) [3]	n=11814 (ASD); SPARK; Children; DCD questionnaire	ADHD: 40.8%	
Bowden et al. (2020) [6]	n=8955 (ASD), n=1551342 (non-ASD); Age: 0-24; IDI database, New Zealand	ADHD: 26.8% (ASD), 1.2% (non-ASD)	aOR: 13.8 (95% CI: 13.42-14.3) - standardized for age, sex, ethnicity, deprivation, and urban/rural
Bougeard et al. (2021) [5]	Review: N=17	ADHD, Range: 0% - 86%	
Chien et al. (2021) [9]	n=3837 (ASD), n=38370 (non-ASD); Children; Taiwan's claims database; 2000, 2005, 2010	54.6% (ASD), 6.2% (non-ASD)	
Rødgaard et al. (2021) [40]	n=11,914 (ASD, men), n=4212 (ASD, women); Age ≤16; Danish National Patient Registry	ADHD: 35% (men with ASD), 26% (women with ASD)	
Ivanović (2021) [20]	n=152 (ASD); Mean age: 8.02 (4.26); Autism Center, Montenegro	ADHD: 17.76%	
Angell et al. (2021) [2]	n=18355 (ASD, girls), n=65145 (ASD, boys); Age: 1-21; healthcare claims data; integrates ICD-9 and ICD-10 codes	ADHD: 55.15% (ASD, girls), 61.03% (ASD, boys)	aOR: 0.76 (95% CI: 0.74-0.79), p:<0.001 - adjusted for age, race, ethnicity, urbanicity, and insurance
Huang et al. (2021) [18]	n=6599 (ASD), n=26396 (non-ASD); controls age, sex, date matched 1:4; All ages, mean: 5.1 (ASD), 5.8 (non-ASD); Taiwan National Health Insurance Research Database; ICD-9; 2000-15	ADHD: 23.1% (ASD), 1.0% (non-ASD)	p: <0.01

Table 10: Prevalence of ADHD in those with ASD, table 3.

Source	Sample	Prevalence	Other Notes
Shoaib et al. (2022) [45]	n=29694 (ASD, medicaid), IBM Marketscan Multi-State Medicaid Database; n=6719 (ASD, Optum), Optum De-Identified Clinformatics Data Mart Database, Date of Death; US; 2015-16	ADHD: 44.16% (Optum), 50.49% (Medicaid)	
Jadav and Bal (2022) [21]	n=4657 (ASD); Adults; online survey, SPARK; 2022	ADD/ADHD: 44%	
Mutluer et al. (2022) [35]	Review, N=15; population and EHR studies (age 6-18)	Prevalence in studies: 28% - 83%	
Schott et al. (2022) [43]	n=155,617 (ASD), n=466,851 (non-ASD); Adults; Medicaid; 2008–12	Attention deficit disorder: 20.14% (ASD), 8.32% (non-ASD)	aOR: 2.02 (1.98 2.07)
Underwood et al. (2022) [47]	n=7943 (core ASD), n=25941 (control); Age: ≥18; UK; SAIL Databank, 2001-16	7.0% (ASD), 0.7% (non-ASD)	
Koceski and Trajkovski (2022) [24]	n=72 (ASD), n=75 (non-ASD); Age: 3-24; Rochester Health Status Survey IV, Macedonia; 2019	ADD/ADHD: 19.4% (ASD), 0% (non-ASD)	p: 0.000
Hughes et al.(2023) [19]	n=1846 (ASD); ADDM Network (5 sites, USA); 2018	28% had ADHD	
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=72 [N=49 (clinical studies from community samples), N=23 (population/registry based)], n=208,789	Pooled prevalence: 37%, Range: 28% - 46%	
Rim et al. (2023) [38]	n=381 (ASD), n=6179 (non-ASD); Age: 0-19; National Health Insurance System National Sample Cohort; South Korea; 2002–13	23.81% (ASD), 1.79% (non-ASD)	aOR: 13.03 (10.94,15.52)

Table 11: Prevalence of ADHD in those with ASD, table 4.

Source	Sample	Prevalence	Other Notes
Semovski et al. (2023) [44]	n=2020 (ASD); Age: 12-18; records + interviews; Canada	ADHD: 48.9% (ASD)	
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at time of registration; 1999-2019	ADHD: 35.3% (ASD), 16.8% (non-ASD)	p: <0.05
O'Nions et al. (2024) [36]	n=13,172 (ASD, men, no ID), n=3958 (ASD, women, no ID) n=4850 (ASD+ID, men) n=1600 (ASD+ID, women); comparison are 1:10 matched by age, sex, ID status, general practice registered to; mortality study; UK; 1989-2019	ADHD: Men: 15.55% (ASD, no ID); 1.91% (comparison). Women: 9.42% (ASD, no ID); 0.43% (comparison). Men: 12.62% (ASD + ID); 1.49% (comparison). Women: 7.88% (ASD + ID); 0.26% (comparison).	
Longo et al. (2024) [28]	n=30258 (ASD), n=60516 (non-ASD); Age: 18-64; IBM Market Scan Commercial Claims and Encounters Database; 2019-20	ADHD: 34.1% (ASD), 7.4% (non-ASD)	aOR: 6.5 (95% CI: 6.3, 6.8)
Hsu et al. (2024) [17]	n=22698 (ASD), [n=19191 (male), n=3507 (female)]; Age: 2-19; Taiwan's National Health Insurance Research Database; 2001-11; ICD-9	ADHD: 46.9% (ASD, total); 48.6% (ASD, male), 37.1% (ASD, female)	RR: 1.63 (95% CI: 1.52-1.76) [Male vs female (ref)] - adjusted for age, income, residence, and parental psychiatric disorders.
Salehi et al. (2025) [41]	n=2568 (ASD); Age: 3-17; The National Survey of Children's Health; USA; 2020-21	44.3%	OR: 0.8, p = 0.007 [Female vs Male]
Diemer et al. (2025) [12]	n=1424 (ASD); Adult; SPARK	ADHD: 46.07% (total), 46.73% (diagnosed <18), 45.65% (diagnosed >18)	p-value 0.699 (between age groups)

1.2.2 Conduct and Oppositional Disorders

Conduct, Behavior, and Disruptive Disorders

Table 12: Prevalence of combined, overlapping, and unspecified conduct, behavior, and disruptive disorders in those with ASD.

Source	Sample	Prevalence	Other Notes
Schendel et al. (2016) [42]	n=20492 (ASD), 1892412 (non-ASD); Age: >1.5; Danish Civil Registration Service and Medical Birth Register; born 1980-2010	Behavioral and emotional disorders with juvenile onset: 39.4% (ASD), 2.4% (non-ASD)	
Davignon, et al. (2018) [11]	n=4123 (ASD), n=20615 (non-ASD, non-ADHD); Age: 14-25; Kaiser Permanente Northern California, 2013-15	Disruptive, impulse, and conduct disorders: 3.5% (ASD), 0.3% (non-ASD)	aOR (95% CI): 11.93 (8.75 - 16.26)
Lai, et al. (2019) [26]	Meta-analysis, N=96	Disruptive/ impulsive/ conduct disorder: 12%	
Hossain et al. (2020) [15]	Umbrella Review, N=3	Disruptive, impulse-control, and conduct disorders: 12% - 48%	
Huang et al. (2021) [18]	n=6599 (ASD), n=26396 (non-ASD); controls age, sex, date matched 1:4; All ages, mean: 5.1 (ASD), 5.8 (non-ASD); Taiwan National Health Insurance Research Database; ICD-9; 2000-15	Impulse control disorder: 3.4% (ASD), 0.5% (non-ASD)	p: <0.01
Jadav and Bal (2022) [21]	n=4657 (ASD); Adults; online survey, SPARK; 2022	Disruptive disorder: 45.5%	
Rim et al. (2023) [38]	n=381 (ASD), n=6179 (non-ASD); Age: 0-19; National Health Insurance System National Sample Cohort; South Korea; 2002–13	Behavioral and emotional disorders: 31.99% (ASD), 3.33% (non-ASD)	aOR: 10.82 (9.25,12.65)
Salehi et al. (2025) [41]	n=2568 (ASD); Age: 3-17; The National Survey of Children's Health; USA; 2020-21	Behavioral and Conduct Problems: 57.8%	

Conduct Disorders

Table 13: Prevalence of conduct disorders in those with ASD.

Source	Sample	Prevalence	Other Notes
Lever and Geurts (2016) [27]	n=138 (ASD), n=170 (non-ASD); Age: 19-79; Mental Health Institutions and online recruitment; Netherlands	Conduct disorder: 2.2% (ASD), 0.6% (non-ASD)	
Houghton et al. (2017) [16]	n=46943 (ASD, commercial), Truven Health MarketScan Commercial Database, 2014; n=46696 (ASD, Medicaid), Truven Health MarketScan Multi-State Medicaid Database; Age: >3	Conduct disorder: 11.82% (commercial), 19.34% (medicaid)	
Mosner et al. (2019) [34]	n=67 (ASD); Age: 8-25; UNC Autism Research Registry; MINI-KID-P assessment and caregiver report	Conduct disorder: 5.7% (MINI-KID-P), 0% (caregiver report)	
Ivanović (2021) [20]	n=152 (ASD); Mean age: 8.02 (4.26); Autism Center, Montenegro	Conduct disorder: 13.10%	
Bowden et al. (2020) [6]	n=8955 (ASD), n=1551342 (non-ASD); Age: 0-24; IDI database, New Zealand	Conduct: 1.2% (ASD), 0.1% (non-ASD)	aOR: 7.2 (95% CI: 5.8-8.6) - standardized: age, sex, ethnicity, deprivation, urban/rural
Rødgaard et al. (2021) [40]	n=11,914 (ASD, men), n=4212 (ASD, women); Age: ≤16; Danish National Patient Registry	Conduct disorder; 5% (men with ASD), 3% (women with ASD)	
Yule (2021) [1]	n=206 (ASD), n=156 (ADHD), n=156 (controls, age matched); age: ≥ 12; 2007-16; high functioning ASD - academic center	Conduct disorders: 12% (ASD), 22% (ADHD), 3% (control)	p: (ASD vs ADHD), p: <0.05 (ASD vs controls), p: <0.001 (ADHD vs controls)
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; 1999-2019; Age: <18 (registration)	Conduct Disorder, estimatedly: 3% (ASD), 1% (non-ASD)	p: <0.05
Diemer et al. (2025) [12]	n=1424 (ASD); Adult; SPARK	Conduct: 1.05% (total), 2.04% (diagnosed <18), 0.54% (diagnosed >18)	p-value 0.008 (between age groups)

Disruptive Disorder

Table 14: Prevalence of disruptive disorders in those with ASD, table 2.

Source	Sample	Prevalence	Other Notes
Brookman-Frazee et al. (2018) [7]	n=201 (ASD); Age: 4-14; data from community effectiveness trial; Southern California; 2012-15; MINI-KID-P	Oppositional defiant disorder: 58% (ASD)	
Soke et al. (2018) [46]	n=783 (ASD, age: 4), n=1091 (ASD, age; 8), ADDMN - 5 sites (Arizona, Missouri, New Jersey, Utah, and Wisconsin), 2010	ODD: 0.89% (ASD, age: 4), 4.03% (ASD, age: 8)	Adjusted prevalence, 95% CI: 4.13 (1.75, 9.75) [8 vs 4 years] - adjusted for sex, ethnicity, maternal education, location
Mosner et al. (2019) [34]	n=67 (ASD); Age: 8-25; UNC Autism Research Registry; MINI-KID-P assessment and caregiver report	ODD: 40.0% (MINI-KID-P), 0% (caregiver report)	
Bowden et al. (2020) [6]	n=8955 (ASD), n=1551342 (non-ASD); Age: 0-24; IDI database, New Zealand	ODD: 5.1% (ASD), 0.2% (non-ASD)	aOR: 17.8 (95% CI: 16.0-19.6) - standardized for age, sex, ethnicity, deprivation, and urban/rural
Ivanović (2021) [20]	n=152 (ASD); Autism Center, Montenegro	Disruptive mood dysregulation disorder: 9.87%	
Yule (2021) [1]	n=206 (ASD), n=156 (ADHD), n=156 (controls, age matched); age: $\geq$ 12; 2007-16; high functioning ASD - academic center	ODD/Antisocial personality disorder: 52% (ASD), 54% (ADHD), 9% (control)	p: ns (ASD vs ADHD), p: <0.001 (ASD vs controls), p: <0.001 (ADHD vs controls)
Mutluer et al. (2022) [35]	Review, N=10, population and EHR studies (age 6-18)	Disruptive Behavior Disorder: 12% - 48%	
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=24 [N=18 (clinical studies from community samples), N=6 (population/registry based)], n=18,842	Disruptive Behavior: Pooled prevalence: 28%, Range: 21% - 36%	

Table 15: Prevalence of disruptive disorders in those with ASD, table 2.

Source	Sample	Prevalence	Other Notes
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=42 [N=26 (clinical studies from community samples), N=16 (population/registry based)], n=163,225	Disruptive Impulse Control Disorder: Pooled prevalence: 17%, Range: 13% - 22%	
Semovski et al. (2023) [44]	n=2020 (ASD); Age: 12-18; records + interviews; Canada	Disruptive behavior disorder: 19.5% (ASD)	
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at time of registration; 1999-2019	Disruptive mood dysregulation disorder, estimated: 3% (ASD), 1% (non-ASD)	p: <0.05
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at time of registration; 1999-2019	ODD, estimated: 7% (ASD), 3% (non-ASD)	p: <0.05
Hsu et al. (2024) [17]	n=22698 (ASD), [n=19191 (male), n=3507 (female)]; Age: 2-19; Taiwan's National Health Insurance Research Database; 2001-11; ICD-9	Disruptive behavior disorder: 6.4% (ASD, total); 6.6% (ASD, male), 5.1% (ASD, female)	RR: 1.38 (95% CI: 1.17-1.62) [Male vs female (ref)] - adjusted for age, income, residence, and parental psychiatric disorders.
Mayes et al. (2024) [31]	n=2400 (ASD) [n = 1,077 Autism+ADHDC, 120 Autism+ADHD-I, 152 Autism Only, 743 ADHD-C Only, and 308 ADHD-I only]; Age: 3-17; [ADHD-Combined presentation (ADHD-C) (i.e., children who have hyperactivity, impulsivity, and inattention); ADHD-Inattentive presentation (ADHD-I).]; Parent completed Pediatric Behavior Scale	ODD: 23.7% (ASD, only), 61.9% (ASD+ADHD-C), 27.5% (ASD+ADHD-I), 53.3% (ADHD-C, only), 14.3% (ADHD-I, only)	
Diemer et al. (2025) [12]	n=1424 (ASD); Adult; SPARK	ODD: 4.85% (total), 8.57% (diagnosed <18), 2.79% (diagnosed >18)	p-value <0.001 (between age groups)

1.3 Speech and Language Disorders

Table 16: Prevalence of speech and language disorders in those with ASD.

Source	Sample	Prevalence	Other Notes
Davignon, et al. (2018) [11]	n=4123 (ASD), n=20615 (non-ASD, non-ADHD); Age: 14-25; Kaiser Permanente Northern California, 2013-15	Language Disorder: 1.8% (ASD), 0.01% (non-ASD)	aOR (95% CI): 194.78 (47.62-796.57)
Soke et al. (2018) [46]	n=783 (ASD, age: 4), n=1091 (ASD, age; 8), ADDMN - 5 sites (Arizona, Missouri, New Jersey, Utah, and Wisconsin), 2010	Language disorder: 26.05% (ASD, age: 4), 34.83% (ASD, age: 8)	Adjusted prevalence, 95% CI: 1.39 (1.19, 1.62) [8 vs 4 years] - adjusted for sex, ethnicity, maternal education, location
Dizitzer et al. (2020) [13]	n=459 (ASD), n=2285 (non-ASD); Children, southern Israel, Negev Autism Center database, born 2009-16, controls age, sex, ethnicity matched	Developmental disorder; speech/language: 9.2% (ASD), 0.7% (non-ASD)	OR: 13.44 (95% CI: 7.58-23.83), p:<0.001
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=4 [N=1 (clinical studies from community samples), N=3 (population/registry based)], n=8979	Language disorder: Pooled prevalence: 16%, Range: 0% - 53%	
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at time of registration; 1999-2019	Social communication disorder, estimated: 19% (ASD), 2% (non-ASD)	p: <0.05

1.4 Motor disorders

Tic and Tourettes

Table 17: Prevalence of movement disorders in those with ASD, table 1.

Source	Sample	Prevalence	Other Notes
Kalyva et al. (2016) [22]	Review - N=20	Tourette syndrome: 4% - 5%, Tic Disorder: 9-12%	
Davignon, et al. (2018) [11]	n=4123 (ASD), n=20615 (non-ASD, non-ADHD); Age: 14-25; Kaiser Permanente Northern California, 2013-15	Tic Disorder: 1.48% (ASD), 0.02% (non-ASD)	59.36 (23.69 - 148.73)
Mosner et al. (2019) [34]	n=67 (ASD); Age: 8-25; UNC Autism Research Registry; MINI-KID-P assessment and caregiver report	Tourette's Disorder: 5.7% (MINI-KID-P), 2.9% (caregiver report)	
Chien et al. (2021) [9]	n=3837 (ASD), n=38370 (non-ASD); Children; Taiwan's claims database; 2000, 2005, 2010	Tic disorder: 5.9% (ASD), 1.3% (non-ASD)	
Rødgaard et al. (2021) [40]	n=11,914 (ASD, men), n=4212 (ASD, women); Age $\leq$16; Danish National Patient Registry	Tic disorder: 9% (men with ASD), 4% (women with ASD)	
Huang et al. (2021) [18]	n=6599 (ASD), n=26396 (non-ASD); controls age, sex, date matched 1:4; All ages, mean: 5.1 (ASD), 5.8 (non-ASD); Taiwan National Health Insurance Research Database; ICD-9; 2000-15	Tic Disorder: 16.9% (ASD), 0.8% (non-ASD)	p: <0.01
Jadav and Bal (2022) [21]	n=4657 (ASD); Adults; online survey, SPARK; 2022	Tourette's or tic disorder: 4.1%	
Koceski and Trajkovski (2022) [24]	n=72 (ASD), n=75 (non-ASD); Age: 3-24; Rochester Health Status Survey IV, Macedonia; 2019	Tics: 6.9% (ASD), 2.6% (non-ASD)	p:0.25
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=38 [N=30 (clinical studies from community samples), N=8	Tic disorder: Pooled prevalence: 10%, Range: 8% - 13%	

Table 18: Prevalence of movement disorders in those with ASD, table 2.

Source	Sample	Prevalence	Other Notes
Rim et al. (2023) [38]	n=381 (ASD), n=6179 (non-ASD); Age: 0-19; National Health Insurance System National Sample Cohort; South Korea; 2002–13	Tic disorder: 3.05% (ASD), 0.52% (non-ASD)	aOR: 4.02 (2.66,6.05)
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at time of registration; 1999-2019	Tourette syndrome or tic disorder, estimated: 3% (ASD), 1% (non-ASD)	p: <0.05
Salehi et al. (2025) [41]	n=2568 (ASD); Age: 3-17; The National Survey of Children's Health; USA; 2020-21	Tourette syndrome: 1.7%	

Cerebral Palsy

Table 19: Prevalence of cerebral palsy in those with ASD.

Source	Sample	Prevalence	Other Notes
Croen et al. (2015) [10]	n=1507 (ASD), n=15070 (age, sex matches controls); Adults; Kaiser Permanente Northern California; 2008-12	3.58% (ASD), 0.21% (non-ASD)	Chi-square p value: <0.001
Davignon, et al. (2018) [11]	n=4123 (ASD), n=20615 (non-ASD, non-ADHD); Age: 14-25; Kaiser Permanente Northern California, 2013-15	Cerebral palsy and other paralytics syndromes: 2.3% (ASD), 0.3% (non-ASD)	aOR (95% CI): 7.37 (5.29 - 10.29)
Chien et al. (2021) [9]	n=3837 (ASD), n=38370 (non-ASD); Children; Taiwan's claims database; 2000, 2005, 2010	Cerebral Palsy: 7.5% (ASD), 0.5% (non-ASD)	
Pan et al. (2021) [37]	Review, N=17 [N=7 (case control), N=10 (prevalence)], n=39692	Cerebral Palsy: Range: 0.8% - 13.9%	Pooled estimate of proportion: 2.8 (1.6-4.2)
Schott et al. (2022) [43]	n=155,617 (ASD), n=466,851 (non-ASD); Adults; Medicaid; 2008–12	Cerebral palsy: 6.96% (ASD), 10.72% (non-ASD)	aOR: 0.61 (0.59 0.63)
Salehi et al. (2025) [41]	n=2568 (ASD); Age: 3-17; The National Survey of Children's Health; USA; 2020-21	Cerebral Palsy: 1.2%	OR: 2.2, p = 0.042 [Female vs Male]

Table 20: Prevalence of ASD in those with cerebral palsy.

Source	Sample	Prevalence	Other Notes
Casseus et al. (2024) [8]	n=994 (cerebral palsy); Age: 3-26; electronic health records; 2016-21	ASD: 8.2% (CP)	aOR: 2.17 (1.22-3.84), p=0.0080 [Male vs Female]; aOR: 0.53 (95% CI: 0.29-0.99), p=0.0455 [spastic -bilateral vs non-spastic]

Coordination

Table 21: Prevalence of coordination disorders in those with ASD.

Source	Sample	Prevalence	Other Notes
Soke et al. (2018) [46]	n=783 (ASD, age: 4), n=1091 (ASD, age; 8), ADDMN - 5 sites (Arizona, Missouri, New Jersey, Utah, and Wisconsin), 2010	Developmental disability - motor: 21.58% (ASD, age: 4), 26.86% (ASD, age: 8)	Adjusted prevalence, 95% CI: 1.30 (1.08, 1.56) [8 vs 4 years] - adjusted for sex, ethnicity, maternal education, location
Miller et al. (2021) [33]	n=43 (ASD), n=18 (Developmental coordination disorder); Age: 5-19; community sampled recruited via fliers and internet notices from 2 projects	Motor coordination: Very low: 46.5% (ASD), 55.6% (DCD), Low: 14% (ASD), 22.2% (DCD), Below average: 20.9% (ASD), 16.7% (DCD), Average: 16.3% (ASD), 5.6% (DCD)	
Bhat et al. (2020) [3]	n=11814 (ASD); SPARK; Children; DCD questionnaire	Developmental coordination disorder: 15.1% (diagnosed); Motor impairment - at risk for DCD: 86.9% (based on DCDQ scores)	
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=2 [N=2 (clinical studies from community samples), N=0 (population/registry based)], n=11857	Developmental Coordination Disorder: Pooled prevalence: 87%, Range: 87% - 88%	
Micai et al. (2023) [32]	Meta-analysis of observational studies, N=12 [N=6 (clinical studies from community samples), N=6 (population/registry based)], n=25945	Motor Problem: Pooled prevalence: 40%, Range: 19% - 64%	
Khachadourian et al. (2023) [23]	n=42569 (ASD), n=11389 (non-ASD siblings); SPARK; Age: <18 at start; 1999-2019	Motor delay, estimated: 18% (ASD), 3% (non-ASD)	p: <0.05

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