

## Supporting Information

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**Table S1. Effects of Age on ASD-related Traits Associated with Sleep Duration.** Reported are results from interaction analyses that evaluated the influence of age on the associations of ASD-related traits with sleep duration. For the traits where age significantly influenced the association with sleep duration, the direction of the effect for the interaction when compared to the main effects changes as age increases. This suggests that shorter sleep duration has a stronger relationship with increased severity of ASD-related traits in younger children, and that severity of ASD-related traits is increased for older children who were reported to sleep longer.

†The  $\beta$ -coefficient indicates the number of minutes sleep duration increases as severity scores increase for each year of age. ADI-R=Autism Diagnostic Interview-Revised, ADOS=Autism Diagnostic Observation Schedule, RRB=restricted and repetitive behaviors, NV=non-verbal, MHI=medical history intake, CBCL=Child Behavior Checklist, df=degrees of freedom.

**Table S2. Breakdown of Neurological Conditions Reported in the Medical Histories of the Analysis Dataset.** Reported is the number of children included in the overall analysis dataset (n=2,714) who were reported to have one, or more, of the specified neurological conditions.

**Table S3. Association of Sleep Duration with Current Medication Use.** Results from analyses evaluating the association of sleep duration with current medication use. Shorter sleep duration was associated with current use of attention deficit disorder medications, sedatives, and thalidomide. Longer sleep duration was associated with current use of mood stabilizers. n=number of children reported to be on the medication, ADD=attention deficit disorder, df=degrees of freedom. \*Indicates that age was adjusted for in analysis due to an independent association ( $p<0.05$ ) of age with medication use.

**Table S4. ASD-Related Traits Associated with Sleep Duration in 'Un-Medicating' Children.** Increased severity of social impairment, failure to develop peer relationships, and compulsive nonfunctional rituals from the Autism Diagnostic Interview-Revised (ADI-R) remained significantly associated with shorter sleep duration in children who were not currently taking ADD meds, mood stabilizers, sedatives, or thalidomide.

†For every one unit score increase in the ASD-related trait, or one year increase in age, the  $\beta$ -coefficient represents the number of minutes sleep duration either decreases or increases. ADOS=Autism Diagnostic Observation Schedule, CSS=calibrated severity score, RRB=restricted, repetitive behaviors.

**Table S5. Association of Sleep Duration with Maladaptive Behaviors and Comorbidities in 'Un-Medicating' Children.** Shorter sleep duration remained associated with increased severity for numerous maladaptive behaviors measured with the Child Behavior Checklist (CBCL) and reports of depressive disorder in children not currently taking ADD meds, mood stabilizers, sedatives, or thalidomide. Score ranges for CBCL are included in parentheses next to the variable description.

†For every one unit score increase in the CBCL T Score, the  $\beta$ -coefficient represents the number of minutes sleep duration either decreases or increases; \*Indicates the variable was only available for children evaluated using the CBCL for ages 6-18; \*\*Indicates the variable was only available for children evaluated using the CBCL for ages 2-5. df=degrees of freedom, n=number of children reported to have the comorbidity.

**Table S1. Effects of Age on ASD-related Traits Associated with Sleep Duration.** Reported are results from interaction analyses that evaluated the influence of age on all ASD-related traits that were associated with sleep duration. For the traits where age significantly influenced the association with sleep duration, the direction of the effect for the interaction when compared to the main effects changes as age increases. This suggests that shorter sleep duration has a stronger relationship with increased severity of ASD-related traits in younger children, and that severity of ASD-related traits is increased for older children who were reported to sleep longer.

<b>ASD-Related Trait (df)</b>	<b><math>\beta^{\dagger}</math> (95% CI)</b>	<b>p-value</b>	<b>R<sup>2</sup> (df)</b>
<b>Social Impairment<sub>ADI-R</sub> X Age at ADOS</b>	<b>0.28 (0.15, 0.41)</b>	<b>&lt;1.0x10<sup>-4</sup></b>	<b>0.1604 (2,713)</b>
<b>NV Communication<sub>ADI-R</sub> X Age at ADOS</b>	<b>0.46 (0.24, 0.68)</b>	<b>&lt;1.0x10<sup>-4</sup></b>	<b>0.1522 (2,713)</b>
RRB <sub>ADI-R</sub> X Age at ADOS	0.13 (-0.17, 0.43)	3.9x10 <sup>-1</sup>	0.1456 (2,713)
<b>Failure to Develop Peer Relationships<sub>ADI-R</sub> X Age at ADOS</b>	<b>0.60 (0.18, 1.03)</b>	<b>5.0x10<sup>-3</sup></b>	<b>0.1587 (2,711)</b>
Compulsive Nonfunctional Rituals <sub>ADI-R</sub> X Age at ADOS	0.31 (-0.22, 0.84)	2.5x10 <sup>-1</sup>	0.1450 (2,711)
Attention Deficit Disorder <sub>MHI</sub> X Age at ADOS	1.07 (-1.42, 3.55)	4.0x10 <sup>-1</sup>	0.1432 (2,555)
Depressive Disorder <sub>MHI</sub> X Age at ADOS	-2.23 (-11.92, 7.45)	6.5x10 <sup>-1</sup>	0.1486 (2,521)
Obsessive Compulsive Disorder <sub>MHI</sub> X Age at ADOS	-1.23 (-5.84, 3.38)	6.0x10 <sup>-1</sup>	0.1469 (2,551)
ADD/ADHD <sub>CBCL</sub> X Age at ADOS	0.03 (-0.07, 0.12)	6.0x10 <sup>-1</sup>	0.1466 (2,703)
<b>Affective Problems<sub>CBCL</sub> X Age at ADOS</b>	<b>0.16 (0.08, 0.24)</b>	<b>&lt;1.0x10<sup>-4</sup></b>	<b>0.1754 (2,703)</b>
<b>Anxiety Problems<sub>CBCL</sub> X Age at ADOS</b>	<b>0.14 (0.06, 0.22)</b>	<b>1.0x10<sup>-3</sup></b>	<b>0.1460 (2,704)</b>
<b>Anxious/Depressed<sub>CBCL</sub> X Age at ADOS</b>	<b>0.11 (0.02, 0.19)</b>	<b>1.6x10<sup>-2</sup></b>	<b>0.1434 (2,705)</b>
Attention Problems <sub>CBCL</sub> X Age at ADOS	0.02 (-0.06, 0.10)	6.3x10 <sup>-1</sup>	0.1454 (2,706)
Emotionally Reactive <sub>CBCL</sub> X Age at ADOS	0.13 (-0.68, 0.95)	7.5x10 <sup>-1</sup>	0.0247 (647)
<b>Internalizing Problems<sub>CBCL</sub> X Age at ADOS</b>	<b>0.14 (0.06, 0.22)</b>	<b>1.0x10<sup>-3</sup></b>	<b>0.1490 (2,706)</b>
Pervasive Developmental <sub>CBCL</sub> X Age at ADOS	0.45 (-0.43, 1.33)	3.1x10 <sup>-1</sup>	0.0341 (647)
Sleep Problems <sub>CBCL</sub> X Age at ADOS	0.66 (-0.12, 1.44)	9.8x10 <sup>-2</sup>	0.0909 (644)
Social Problems <sub>CBCL</sub> X Age at ADOS	0.03 (-0.10, 0.15)	6.9x10 <sup>-1</sup>	0.1201 (2,057)
Thought Problems <sub>CBCL</sub> X Age at ADOS	0.04 (-0.07, 0.16)	4.4x10 <sup>-1</sup>	0.1438 (2,057)
<b>Total Problems<sub>CBCL</sub> X Age at ADOS</b>	<b>0.11 (0.03, 0.19)</b>	<b>9.0x10<sup>-3</sup></b>	<b>0.1536 (2,706)</b>

<sup>†</sup>The  $\beta$ -coefficient indicates the number of minutes sleep duration increases as severity scores increase for each year of age. ADI-R=Autism Diagnostic Interview-Revised, ADOS=Autism Diagnostic Observation Schedule, RRB=restricted and repetitive behaviors, NV=non-verbal, MHI=medical history intake, CBCL=Child Behavior Checklist, df=degrees of freedom.

**Table S2. Breakdown of Neurological Conditions Reported in the Medical Histories of the SSC Analysis Dataset.**

Number of Children	Cerebral Palsy	Cranial Nerve Disorder	Abnormal EEG	Encephalitis	Febrile Seizures	Head Injury	Meningitis	Movement Abnormalities	Tourette's or tics	Tuberous Sclerosis
527			√							
81						√				
72									√	
36			√		√					
36								√		
36					√					
33			√			√				
27			√					√		
26			√						√	
11						√			√	
6			√					√	√	
6					√	√				
5							√			
5			√			√			√	
5						√		√		
4	√		√							
4			√		√				√	
4								√	√	
2	√									
2		√								
2			√		√	√				
2			√		√			√		
2			√			√		√		
2					√			√		
2						√	√			
2							√	√		
1	√				√	√				
1			√	√						
1			√	√					√	
1			√				√			



**Table S3. Association of Medication Use with Sleep Duration.** Results reported the association of sleep duration with current medication use.

Medication	$\beta^{\dagger}$ (95% CI)	p-value	R <sup>2</sup> (df)
<b>ADD Meds (n=459)*</b>	<b>-7.57 (-14.83, -0.31)</b>	<b>4.1x10<sup>-2</sup></b>	<b>0.1441 (2,709)</b>
Antibiotics (n=88)*	-2.57 (-17.62, 12.48)	7.4x10 <sup>-1</sup>	0.1430 (2,702)
Antidepressants (n=287)*	-7.07 (-1.96, 16.09)	1.3x10 <sup>-1</sup>	0.1436 (2,706)
Antiepileptics (n=85)*	5.37 (-9.93, 20.68)	4.9x10 <sup>-1</sup>	0.1431 (2,709)
Anti-inflammatories (n=20)	-14.73 (-48.32, 18.86)	3.9x10 <sup>-1</sup>	0.0003 (2,708)
Antihypertensives (n=34)	-13.89 (-39.71, 11.94)	2.9x10 <sup>-1</sup>	0.0004 (2,709)
Asthma Meds (n=165)	-7.22 (-19.24, 4.81)	2.4x10 <sup>-1</sup>	0.0005 (2,709)
Cardiac Problem Meds (n=4)	-22.12 (-97.04, 52.80)	5.6x10 <sup>-1</sup>	0.0001 (2,707)
Diabetes Meds (n=2)	0.25 (-105.26, 105.76)	9.9x10 <sup>-1</sup>	0.0000 (2,707)
High Cholesterol Meds (n=2)*	-32.31 (-131.59, 66.97)	5.2x10 <sup>-1</sup>	0.1351 (2,252)
Misoprostol (n=1)	-14.65 (-164.43, 135.14)	8.5x10 <sup>-1</sup>	0.0000 (2,676)
<b>Mood Stabilizers (n=249)*</b>	<b>13.97 (4.61, 23.33)</b>	<b>3.0x10<sup>-3</sup></b>	<b>0.1457 (2,707)</b>
Pain Killers (n=9)*	4.13 (-42.20, 56.47)	8.6x10 <sup>-1</sup>	0.1428 (2,707)
<b>Sedatives (n=66)*</b>	<b>-23.38 (-40.65, -6.10)</b>	<b>8.0x10<sup>-3</sup></b>	<b>0.1453 (2,707)</b>
<b>Thalidomide (n=2)</b>	<b>-149.73 (-255.51, -43.94)</b>	<b>6.0x10<sup>-3</sup></b>	<b>0.0029 (2,677)</b>
Thyroid Meds (n=12)	2.78 (-40.38, 45.94)	9.0x10 <sup>-1</sup>	0.0000 (2,706)
Tranquilizers (n=26)*	4.09 (-23.27, 31.45)	7.7x10 <sup>-1</sup>	0.1431 (2,706)

n=number of children reported to be on the medication, ADD=attention deficit disorder, df=degrees of freedom. \*Indicates that age was adjusted for in analyses due to an independent association (p<0.05) of age with medication use.

**Table S4. ASD-Related Traits Associated with Sleep Duration in ‘Un-Medicating’ Children.**

Increased severity of social impairment, failure to develop peer relationships, compulsive nonfunctional rituals from the ADI-R remained significantly associated with shorter sleep duration in children who were not currently taking ADD meds, mood stabilizers, sedatives, or thalidomide.

ASD-Related Trait	$\beta^{\dagger}$ (95% CI)	p-value	R <sup>2</sup>
<b>Full Regression Model (df=1,740)</b>			
<b>Social Impairment<sub>ADI-R</sub> (8-30)</b>	<b>-1.11 (-1.90, -0.32)</b>	<b>6.0x10<sup>-3</sup></b>	<b>0.1827</b>
NV Communication <sub>ADI-R</sub> (0-14)	1.91 (-0.16, 3.97)	7.1x10 <sup>-2</sup>	
Verbal Communication <sub>ADI-R</sub> (6-26)	-0.83 (-2.52, 0.85)	3.3x10 <sup>-1</sup>	
RRB <sub>ADI-R</sub> (0-12)	-1.10 (-2.39, 0.19)	9.3x10 <sup>-2</sup>	
Social Affect CSS <sub>ADOS</sub> (2-20)	-0.29 (-1.20, 0.32)	5.4x10 <sup>-1</sup>	
<b>Verbal IQ Score (5-167)</b>	<b>0.25 (0.06, 0.45)</b>	<b>1.0x10<sup>-2</sup></b>	
Non-verbal IQ Score (9-161)	-0.12 (-0.34, 0.10)	2.8x10 <sup>-1</sup>	
<b>Age at ADOS (4-18 years)</b>	<b>-8.35 (-9.34, -7.36)</b>	<b>&lt;1.0x10<sup>-4</sup></b>	
<b>ADI-R Subscale Scores (df=1,779)</b>			
Failure to use nonverbal behaviors (0-6)	-0.76 (-3.26, 1.73)	5.5x10 <sup>-1</sup>	<b>0.1957</b>
<b>Failure to develop peer relationships (0-8)</b>	<b>-4.24 (-6.51, -1.97)</b>	<b>&lt;1.0x10<sup>-4</sup></b>	
Lack of shared enjoyment (0-6)	-0.25 (-2.69, 2.18)	8.4x10 <sup>-1</sup>	
Lack of socioemotional reciprocity (0-10)	0.15 (-1.76, 2.06)	8.8x10 <sup>-1</sup>	
Delay in language or use of gestures (0-8)	0.92 (-0.56, 2.40)	2.2x10 <sup>-1</sup>	
Failure to initiate conversation (0-4)	-2.05 (-6.66, 2.57)	3.8x10 <sup>-1</sup>	
Stereotyped, repetitive or idiosyncratic speech (0-8)	-0.63 (-2.51, 1.26)	5.1x10 <sup>-1</sup>	
Lack of make believe play (0-6)	1.23 (-1.56, 4.01)	3.9x10 <sup>-1</sup>	
Encompassing preoccupation (0-4)	0.37 (-2.38, 3.11)	7.9x10 <sup>-1</sup>	
<b>Compulsive nonfunctional rituals (0-4)</b>	<b>-2.29 (-4.55, -0.04)</b>	<b>4.6x10<sup>-2</sup></b>	
Repetitive motor mannerisms (0-2)	-1.69 (-5.66, 2.27)	4.0x10 <sup>-1</sup>	
Preoccupations with objects (0-2)	-0.58 (-6.11, 4.94)	8.4x10 <sup>-1</sup>	
Verbal IQ Score (5-167)	<b>0.22 (0.03, 0.41)</b>	<b>2.4x10<sup>-2</sup></b>	
Non-verbal IQ score (9-161)	-0.13 (-0.34, 0.09)	2.5x10 <sup>-1</sup>	
<b>Age at ADOS (4-18 years)</b>	<b>-8.48 (-9.42, -7.53)</b>	<b>&lt;1.0x10<sup>-4</sup></b>	

**Table S5. Associations of Sleep Duration with Maladaptive Behaviors and Comorbidities in ‘Un-Medicating’ Children.** Shorter sleep duration remained associated with increased severity for numerous maladaptive behaviors measured with the Child Behavior Checklist (CBCL) and reports of depressive disorder in children not currently taking ADD meds, mood stabilizers, sedatives, or thalidomide. Score ranges for CBCL are included in parentheses next to the variable description.

<b>Child Behavior Checklist T Scores</b>	<b><math>\beta^{\dagger}</math> (95% CI)</b>	<b>p-value (df)</b>	<b>R<sup>2</sup></b>
<b>ADD/ADHD (50-80)</b>	<b>-0.71 (-1.13, -0.29)</b>	<b><math>1.0 \times 10^{-3}</math> (2,035)</b>	<b>0.0053</b>
<b>Affective Problems (50-95)</b>	<b>-0.52 (-0.85, -0.18)</b>	<b><math>3.0 \times 10^{-3}</math> (2,037)</b>	<b>0.0045</b>
<b>Anxiety Problems (50-95)</b>	<b>-0.96 (-1.31, -0.60)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (2,036)</b>	<b>0.0134</b>
<b>Anxious/Depressed (50-98)</b>	<b>-1.10 (-1.48, -0.72)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (2,036)</b>	<b>0.0153</b>
<b>Attention Problems (50-100)</b>	<b>-0.52 (-0.85, -0.18)</b>	<b><math>3.0 \times 10^{-3}</math> (2,037)</b>	<b>0.0045</b>
<b>Emotionally Reactive (50-93)**</b>	<b>-0.99 (-1.64, -0.34)</b>	<b><math>3.0 \times 10^{-3}</math> (597)</b>	<b>0.0148</b>
<b>Internalizing Problems (33-90)</b>	<b>-0.74 (-1.08, -0.40)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (2,037)</b>	<b>0.0088</b>
<b>Pervasive Developmental (50-95)**</b>	<b>-1.37 (-2.04, -0.69)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (597)</b>	<b>0.0260</b>
<b>Sleep Problems (50-100)**</b>	<b>-2.17 (-2.78, -1.57)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (594)</b>	<b>0.0772</b>
<b>Social Problems (50-91)*</b>	<b>-0.81 (-1.29, -0.34)</b>	<b><math>1.0 \times 10^{-3}</math> (1,438)</b>	<b>0.0079</b>
<b>Thought Problems (50-91)*</b>	<b>-1.44 (-1.88, -1.00)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (1,438)</b>	<b>0.0280</b>
<b>Total Problems (27-92)</b>	<b>-0.97 (-1.32, -0.61)</b>	<b><math>&lt;1.0 \times 10^{-4}</math> (2,037)</b>	<b>0.0140</b>
<b>Comorbidity Reports in Medical History</b>	<b><math>\beta^{\dagger}</math> (95% CI)</b>	<b>p-value (df)</b>	<b>R<sup>2</sup></b>
Attention Deficit Disorder (n=92)	-13.53 (-29.30, 2.24)	$9.3 \times 10^{-2}$ (1,912)	0.0015
<b>Depressive Disorder (n=6)</b>	<b>-95.05 (-155.28, -34.83)</b>	<b><math>2.0 \times 10^{-3}</math> (1,897)</b>	<b>0.0050</b>
Obsessive Compulsive Disorder (n=39)	-18.78 (-42.67, 5.11)	$1.2 \times 10^{-1}$ (1,920)	0.0012

<sup>†</sup>For every one unit score increase in the CBCL T Score, the  $\beta$ -coefficient represents the number of minutes sleep duration either decreases or increases; \*Indicates the variable was only available for children evaluated using the CBCL for ages 6-18; \*\*Indicates the variable was only available for children evaluated using the CBCL for ages 2-5. df=degrees of freedom, n=number of children reported to have the comorbidity.