



Supplementary Information for

Disparities in Sleep Duration Among American Children: Effects of Race, Ethnicity, Income, and Sex

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Supplement Table 1: Number of children with reported actigraphy measurements each month by race/ethnicity.

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Asian	10	11	10	8	3	13	6	8	8	12	11	11
Black	31	44	24	23	14	18	27	40	20	38	40	34
Hispanic	84	115	72	58	45	46	52	77	52	55	65	90
Other	45	34	37	29	27	30	20	32	37	30	47	48
White	255	298	257	147	130	168	206	240	156	185	234	240
Total	425	502	400	265	219	275	311	397	273	320	397	423

Supplement Table 2: Number of children with reported actigraphy measurements each month by Income Categories.

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
DNK/RTA	28	37	28	16	15	15	18	24	23	27	25	16
Low-Income	81	101	77	62	38	51	60	82	62	72	94	95
Middle-Income	119	153	121	67	66	67	83	97	66	88	108	126
High-Income	197	211	174	120	100	142	150	194	122	133	170	186
Total	425	502	400	265	219	275	311	397	273	320	397	423

Supplement Table 3: Supplemental Models, variables, assessment tools, ABCD data dictionary search terms and significance

Model	Variables	Assessment Tool	Short Name	Element Name	p=
2	Area Deprivation Index	Residential History Derived Scores	abcd_rhds01	reshist_addr1_adi_wsum	0.2219
3	Age parent had child	ABCD Parent Demographics Survey	pdem02	demo_prnt_age_v2_l	0.8516
4	Discrimination	ABCD Youth Discrimination Measure	abcd_ydmes01	dim_yesno_q1 dim_yesno_q2 dim_yesno_q3 dim_yesno_q4	0.8019
5	Time Child Fell Asleep	ABCD Youth Fitbit Daily Sleep Summaries	abcd_fbdss01	fit_ss_first_sleep_minutes	<0.0001
6	BMI	ABCD Youth Anthropometrics	abcd_ant01	Anthroheightcalc anthroweightcalc	<0.0001

Supplement Table 4. Main model results: Summary of average TST for each Race/Ethnicity and Income category level
Note: Cohen's d is calculated using White Race/Ethnicity as reference for Race/Ethnicity categories and High-income for Income Categories

*DNK/RTA=Do not know/Refused to answer

Variable	N	Mean TST	Std Dev	Lower 95% Mean	Upper 95% Mean	Cohen's d
race_ethnicity						
Asian	111	441.55	38.44	433.92	448.38	-0.37
Black	353	420.87	42.21	416.45	425.29	-0.95
Hispanic	811	445.15	36.11	442.66	447.12	-0.26
Other	416	444.16	36.15	440.67	447.64	-0.29
White	2516	454.14	33.95	452.82	455.47	
Income Categories						
Low-Income	875	438.14	41.15	435.41	440.87	-0.44
Middle-Income	1161	447.67	36.41	445.57	449.76	-0.18
DNK/RTA*	272	444.90	37.29	440.45	449.35	-0.26
High-Income	1899	453.83	33.37	452.33	455.34	

Supplement Table 4 continued: Main model results: Summary of average TST for the interaction between Race/Ethnicity and Income Category Levels. **Note:** Cohen's d is calculated using White race/ethnicity as the reference group within each income category. Cohen's d' uses White High-Income as the reference for interactions between every other Race/Ethnicity* Income Category

Variable	N	Mean TST	Std Dev	Lower 95% Mean	Upper 95% Mean	Cohen's d	Cohen's d'
Race/Ethnicity*Income							
Low-Income							
Asian	9	439.06	48.15	402.05	476.07	-0.22	-0.51
Black	190	416.31	44.16	409.99	422.63	-0.77	-1.15
Hispanic	340	444.59	37.20	440.62	448.55	-0.07	-0.34
Other	95	435.48	42.80	426.76	444.20	-0.31	-0.61
White	241	447.27	36.87	442.59	451.95	0.00	-0.26
Middle-Income							
Asian	27	441.92	45.16	424.06	459.79	-0.31	-0.42
Black	81	420.52	36.81	412.38	428.66	-0.92	-1.07
Hispanic	229	441.57	34.12	437.13	446.01	-0.33	-0.44
Other	98	446.34	36.98	438.92	453.75	-0.19	-0.29
White	726	453.02	35.00	450.47	455.56	0.00	-0.09
High-Income							
Asian	59	444.26	30.02	436.43	452.08	-0.36	-0.36
Black	46	435.46	43.76	422.46	448.45	-0.62	-0.62
Hispanic	168	447.24	35.95	441.77	452.72	-0.26	-0.26
Other	189	450.91	30.15	446.58	455.23	-0.16	-0.16
White	1437	455.97	32.87	454.27	457.67	0.00	0.00
DNK or RTA							
Asian	16	429.61	48.96	403.52	455.70	-0.67	-0.80
Black	36	427.16	37.45	414.48	439.83	-0.77	-0.87
Hispanic	74	454.10	36.32	445.69	462.52	0.04	-0.06
Other	34	424.58	33.70	445.69	462.52	-0.87	-0.95
White	112	452.88	32.25	446.84	458.92	0.00	-0.09

Supplement Table 4 continued: Main model results: Summary of average TST age and sex with 13yr/age and Female as reference Levels.

Variable	N	Mean TST	Std Dev	Lower 95% Mean	Upper 95% Mean	Cohen's d
Age Categories						
9 yr/age	23	473.12	31.12	459.66	486.57	0.91
10 yr/age	256	456.21	33.91	452.03	460.38	0.43
11 yr/age	1891	451.86	35.89	450.24	453.47	0.29
12 yr/age	1819	443.97	37.40	442.25	445.69	0.07
13 yr/age	218	441.50	35.27	436.80	446.21	0.00
Sex						
M	2127	444.99	36.39	443.44	446.54	-0.18
F	2080	451.66	36.68	450.09	453.24	0.00

Supplement Table 4A: Cohen's d Effect Size Ranges

Cohen's d Value	Magnitude
0.1	Very Small
0.2	Small
0.5	Medium
0.8	Large
1.2	Very Large
2.0	Huge

Supplement Table 5: Results of Main Model/Model 1 with each subsequent model incorporating other potential variables driving racial/ethnic and income differences in TST

Note: Models 2-6 were run with an additional variable, and the variable’s interaction with Race/Ethnicity and with Income. All additional models controlled for sex, age, race, and income.

Model 2: Main Model + Area Deprivation Index.

Model 3: Main Model + Age of Parent at Child’s Birth

Model 4: Main Model + Discrimination based on 4 questions (Binary Yes/No). Categories: 0= No Discrimination, 1+= Experienced Discrimination

Model 5: Main Model + Time Child Fell Asleep

Model 6: Main Model + BMI

R/E*=Race/Ethnicity

ADI**= Area Deprivation Index

Parent Age***= Age of the parent when child was born

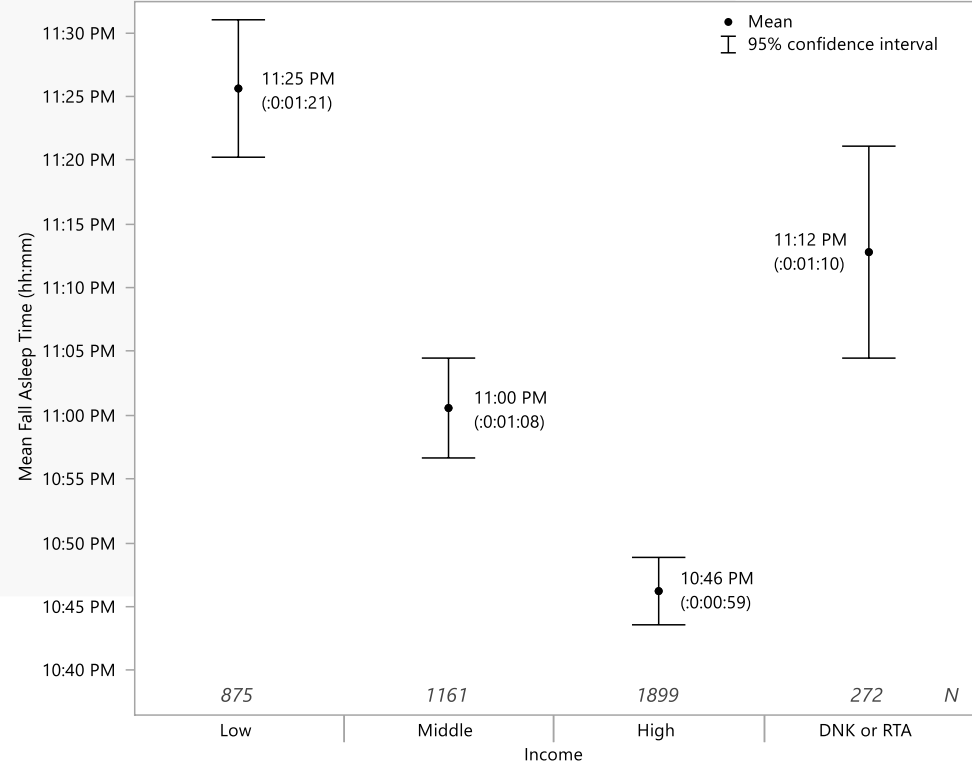
BMI****=Body Mass Index: weight (lb) / [height (in)]² x 703

		Model 2		Model 3		Model 4		Model 5		Model 6	
		p-value		p-value		p-value		p-value		p-value	
Variable	Race/Ethnicity	<0.0001		<0.0001		<0.0001		<0.0001		<0.0001	
	Income	<0.0001		<0.0001		<0.0001		0.0183		<0.0001	
	Sex	<0.0001		<0.0001		<0.0001		<0.0001		<0.0001	
	Age	<0.0001		<0.0001		<0.0001		<0.0001		<0.0001	
	ADI**	0.0136	Parent Age***	0.7453	Discrimination	0.3006	Time Fell Asleep	<0.0001	BMI***	<0.0001	
Interaction	R/E*ADI	0.3521	R/E* Parent Age	0.2381	R/E* Discrimination	0.0887	R/E*Time Fell Asleep	0.0115	R/E*BMI	0.5696	
	Income*ADI	0.3720	Income*Parent Age	0.1689	Income* Discrimination	0.2168	Income*Time Fell Asleep	0.0031	Income*BMI	0.2240	

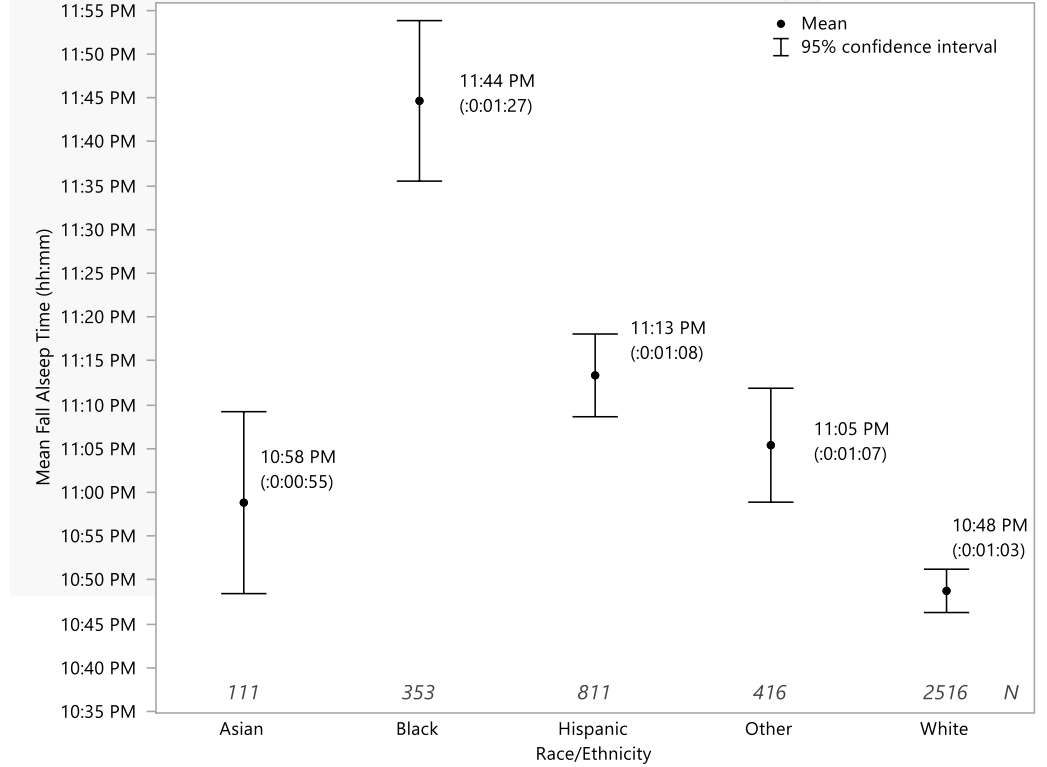
Supplement Table 6: Parameter Estimates of Interactions between Area Deprivation Index (ADI) and Income and Race/Ethnicity

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	545.58764	9.679159	56.37	<.0001*
sex of Race Only[F]	3.7678611	0.544997	6.91	<.0001*
Race/Ethnicity[Asian]	-4.837725	3.335012	-1.45	0.1470
Race/Ethnicity[Black]	-16.00831	1.971609	-8.12	<.0001*
Race/Ethnicity[Hispanic]	5.1438438	1.433953	3.59	0.0003*
Race/Ethnicity[Other]	3.6868262	1.699454	2.17	0.0301*
interview_age of pre-COVID 4207	-0.682401	0.064783	-10.53	<.0001*
reshist_addr1_adi_wsum	-0.085153	0.034505	-2.47	0.0136*
Income Categories[Low]	-4.665496	1.268889	-3.68	0.0002*
Income Categories[Middle]	0.4099094	1.062983	0.39	0.6998
Income Categories[High]	4.077689	0.999439	4.08	<.0001*
(reshist_addr1_adi_wsum-89.5493)*Income Categories[Low]	0.0643297	0.056388	1.14	0.2540
(reshist_addr1_adi_wsum-89.5493)*Income Categories[Middle]	-0.081351	0.049084	-1.66	0.0975
(reshist_addr1_adi_wsum-89.5493)*Income Categories[High]	0.008714	0.039243	0.22	0.8243
Race/Ethnicity[Asian]*(reshist_addr1_adi_wsum-89.5493)	-0.030661	0.080589	-0.38	0.7036
Race/Ethnicity[Black]*(reshist_addr1_adi_wsum-89.5493)	-0.089091	0.068603	-1.30	0.1941
Race/Ethnicity[Hispanic]*(reshist_addr1_adi_wsum-89.5493)	0.079755	0.055307	1.44	0.1494
Race/Ethnicity[Other]*(reshist_addr1_adi_wsum-89.5493)	0.0511038	0.056032	0.91	0.3618

Mean Fall Asleep Time (hh:mm) vs. Income



Mean Fall Alseep Time (hh:mm) vs. Race/Ethnicity



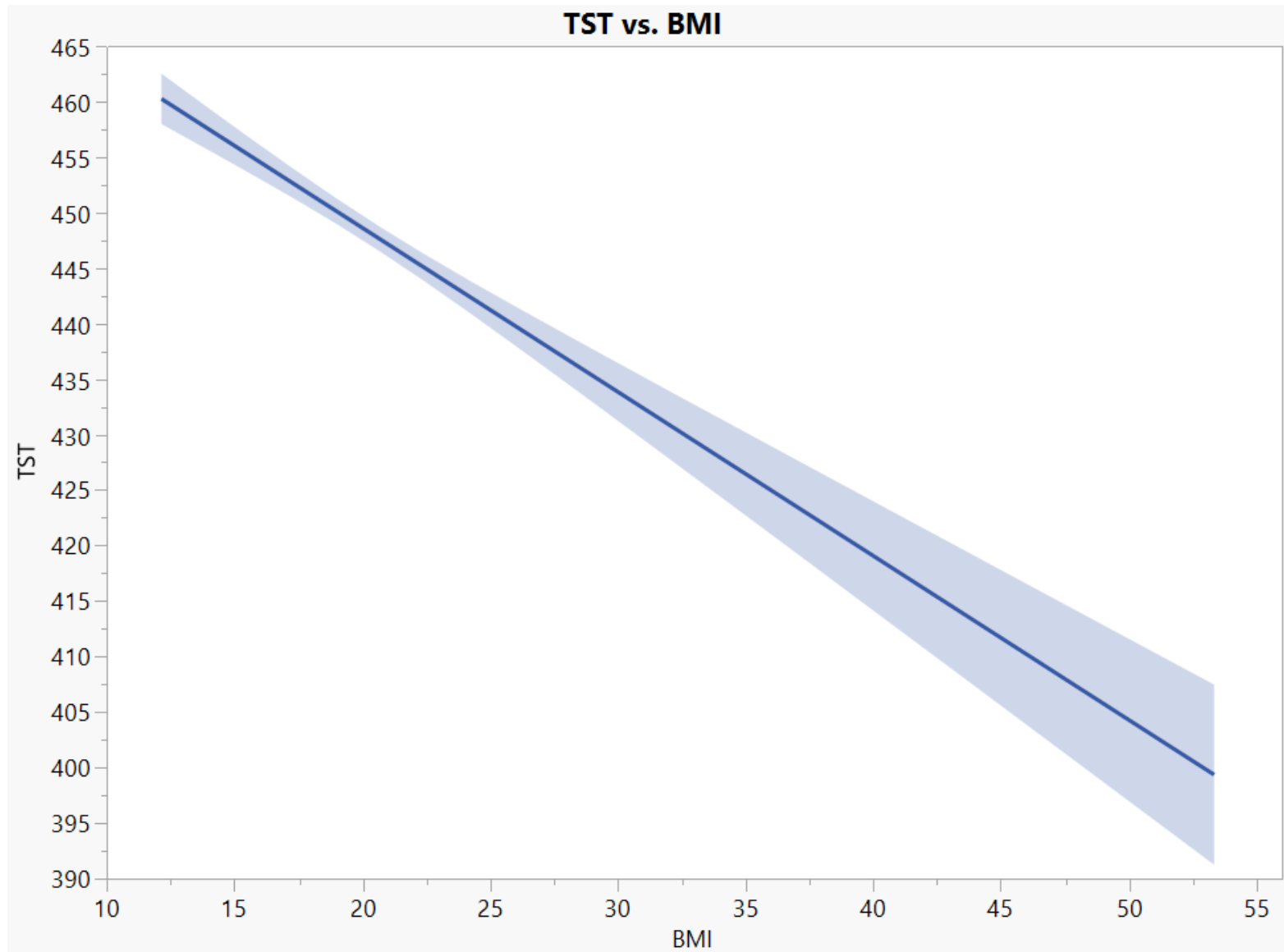
Each error bar is constructed using a 95% confidence interval.

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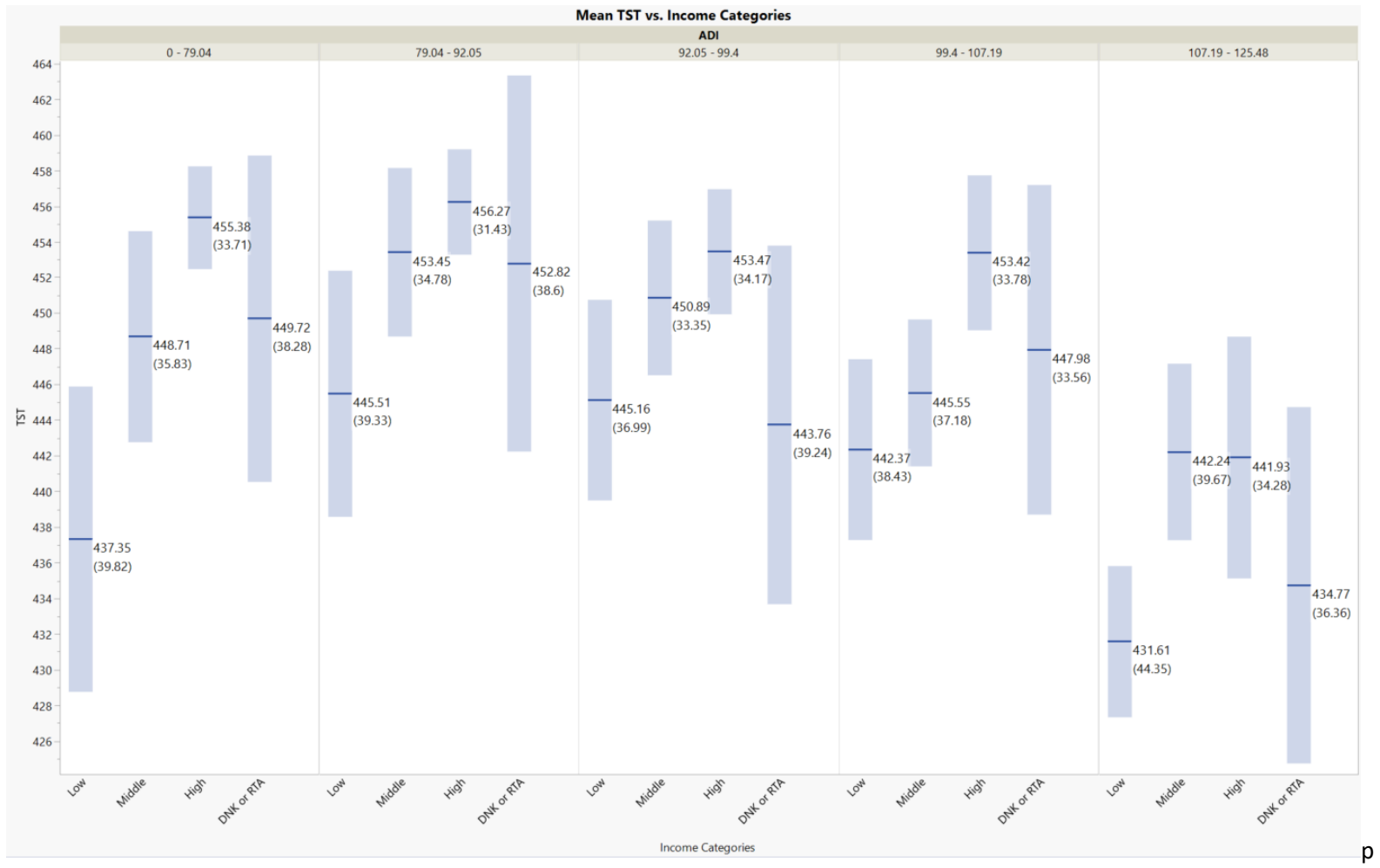
Supplement Figure 1. Average time the child fell asleep at night as a function of (A) Income and (B) Race/Ethnicity.

Source	LogWorth	PValue
Race/Ethnicity	36.801	0.00000
Fall asleep hour and fraction	16.073	0.00000
Income Categories	4.057	0.00009
Fall asleep hour and fraction*Income Categories	2.816	0.00153
Fall asleep hour and fraction*Race/Ethnicity	1.964	0.01086

Supplement Figure 2: Mediation Analysis demonstrating the fraction of selected variables contributions to TST. Figure illustrates the relative contribution of listed variables and their interactions to differences in TST. Log Worth indicates relative size of the effect between sources.



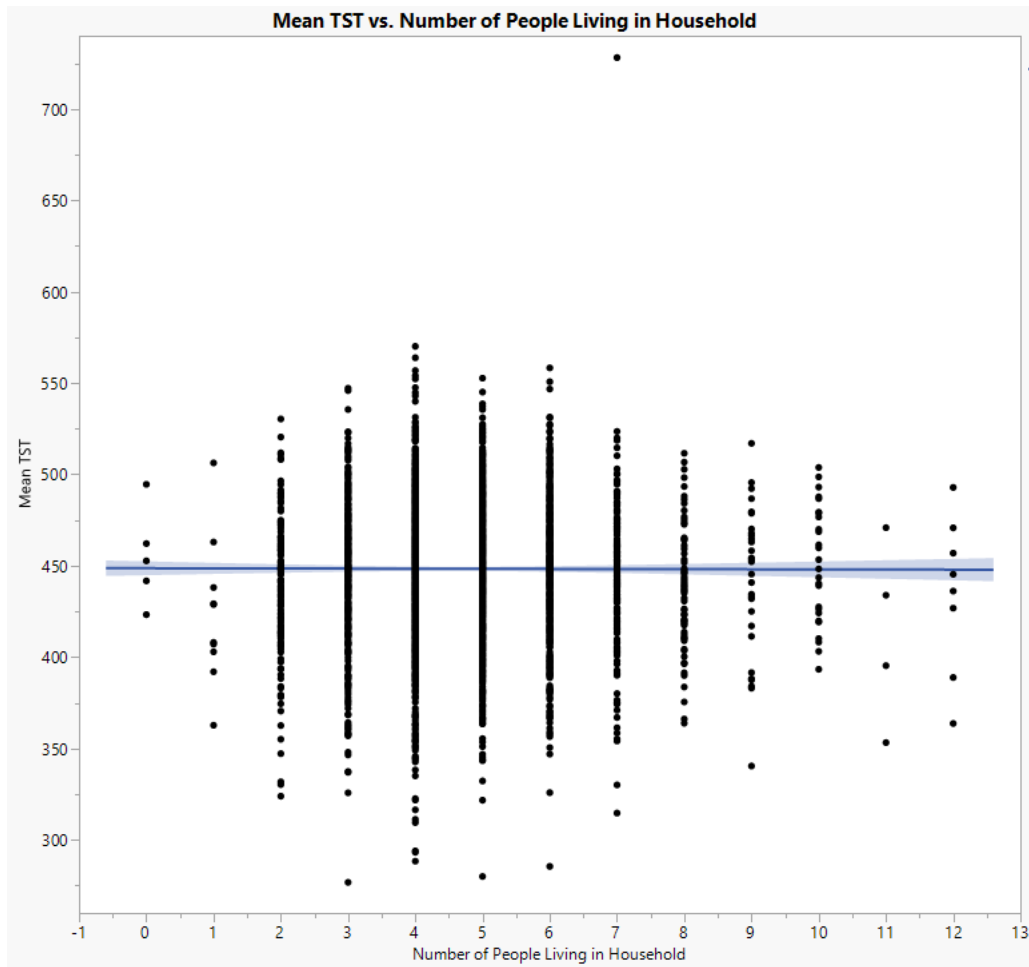
Supplement Figure 3: Regression line demonstrating Children with higher BMI experience less TST



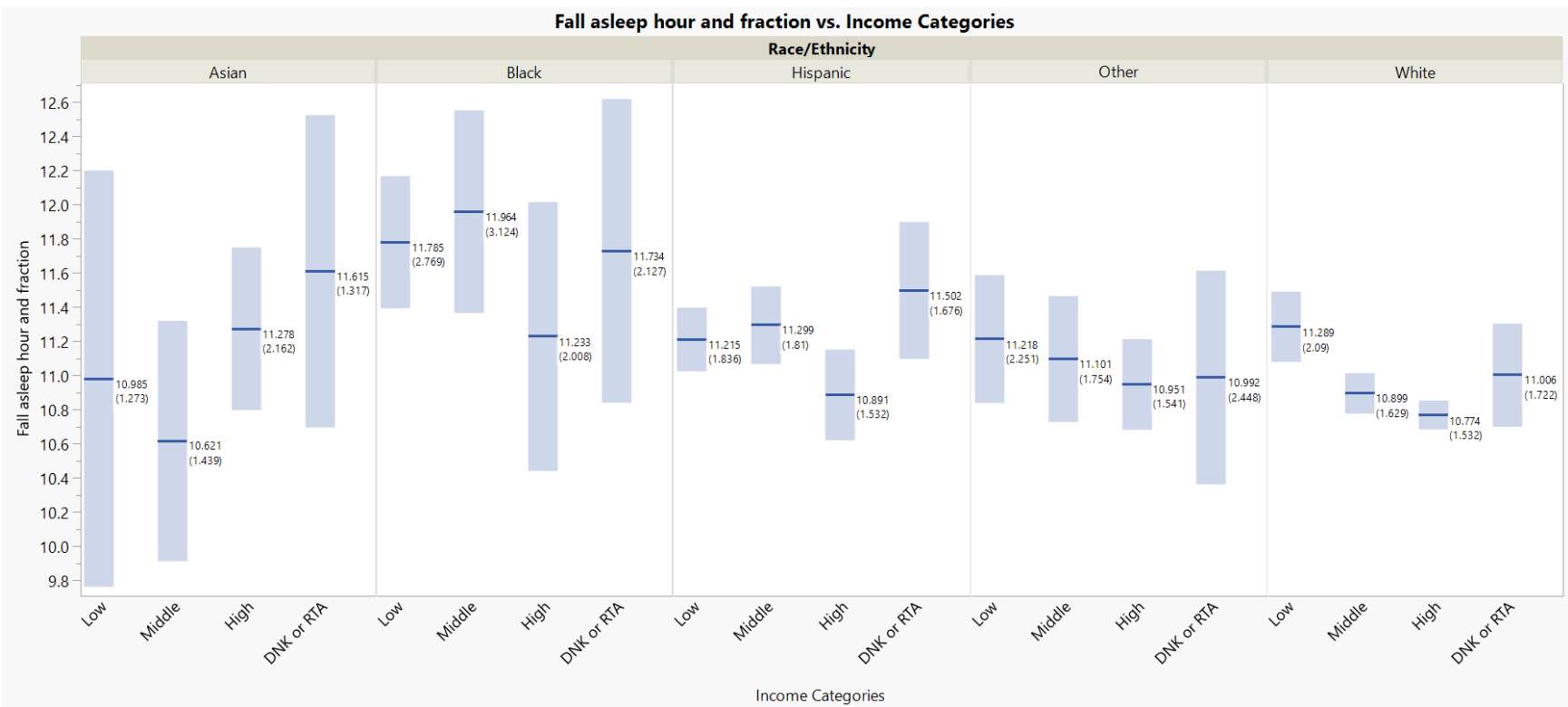
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Supplement Figure 4: Mean TST (SD)* summarized by Income Categories within five ranges of Area Deprivation Index

*Vertical rectangles depict mean(\pm SD) and confidence interval.

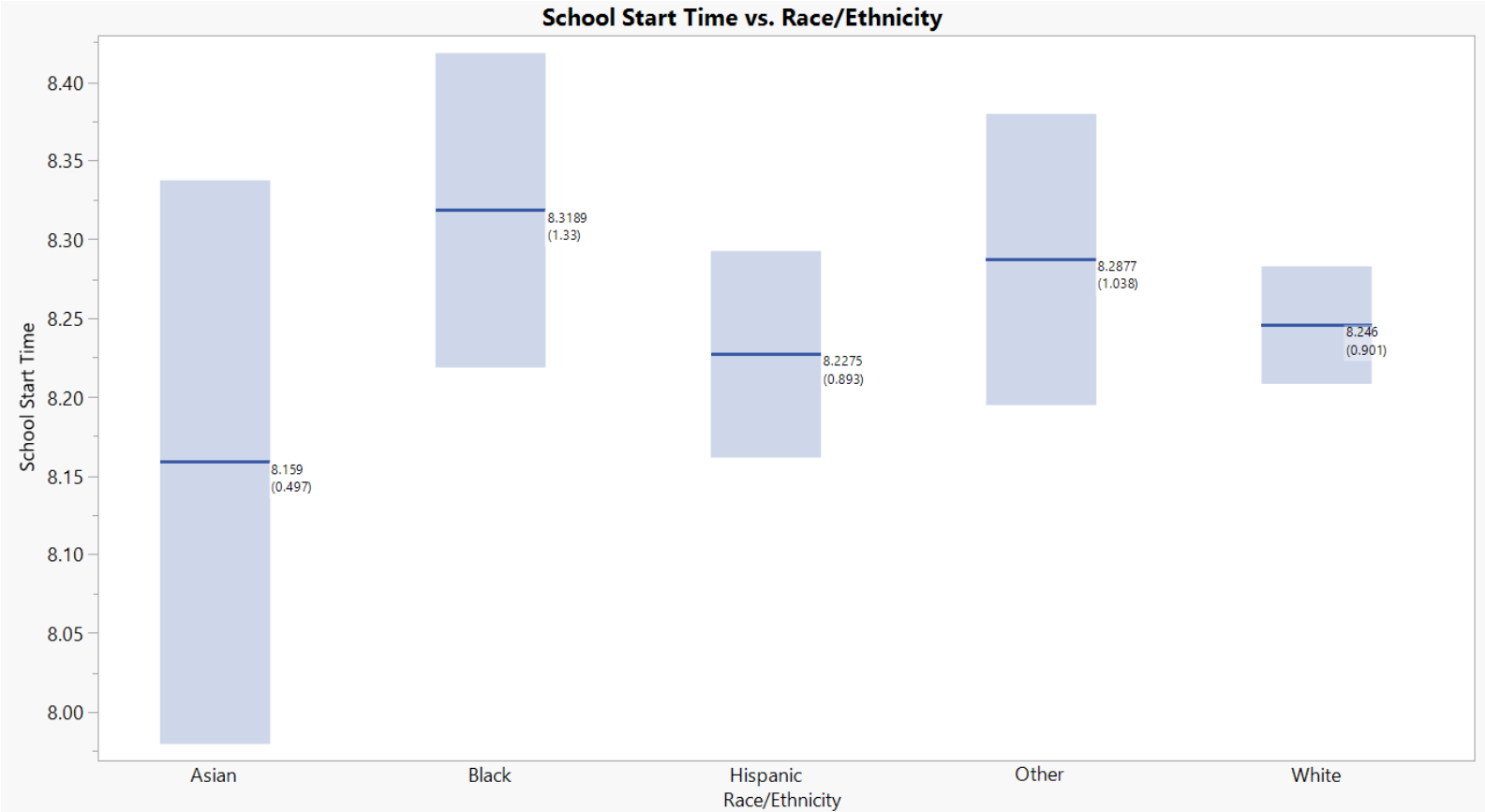


Supplement Figure 5: No significant association between Number of people living in same household and TST.

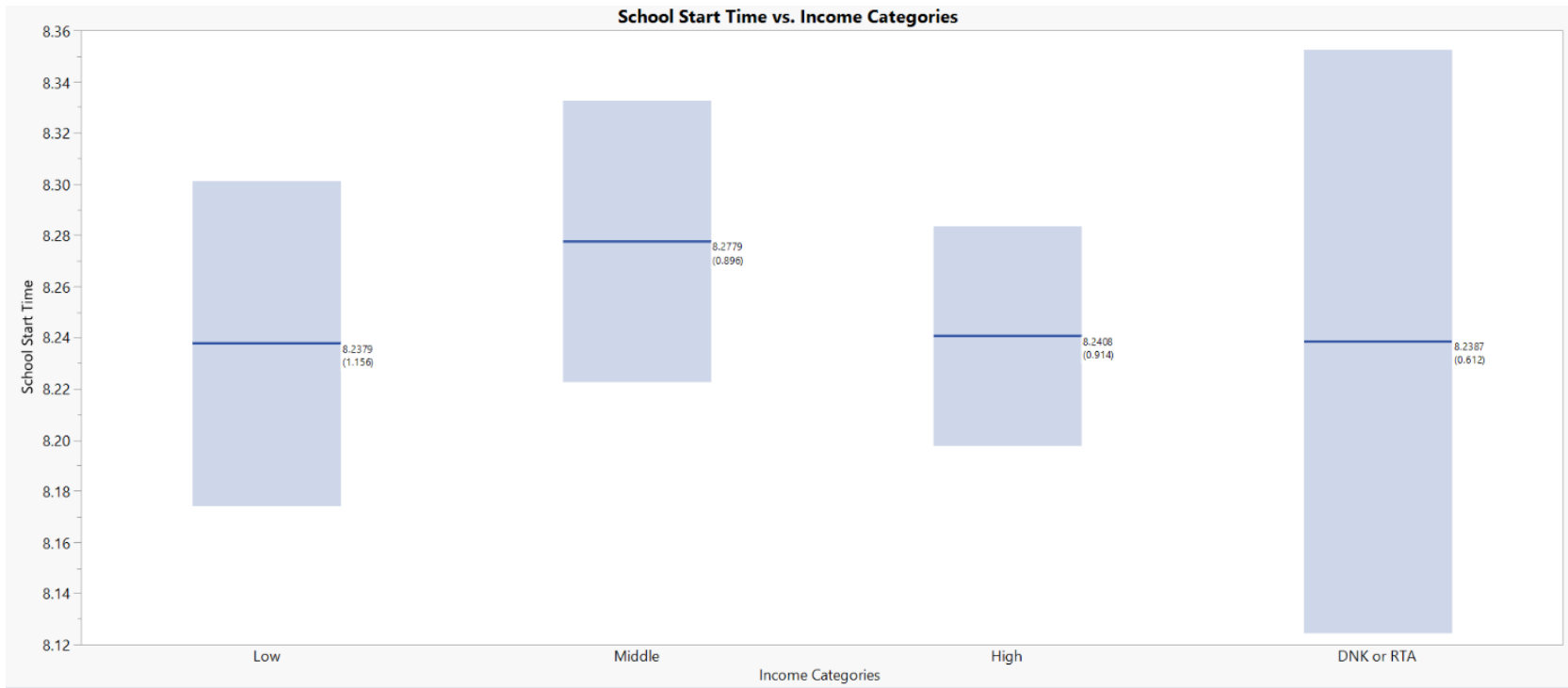


Supplement Figure 6: The effects of Income on time the child went to bed across Racial and Ethnic groups.

*Vertical rectangles depict mean \pm SD



Supplement Figure 7: School Start times by Race/Ethnic Categories



Supplement Figure 8: School Start times by Income Categories