

# The Association between Cortisol Characteristics and Neighborhood Disadvantage in a U.S. Population-Based Sample of Adolescents.

## Supplementary Material

KE Rudolph, GS Wand, EA Stuart, TA Glass, AH Marques, R Duncko, KR Merikangas

Table 1: NCS-A sample characteristics in 2001-2004 by cortisol status. Results are combined across imputations and survey design-based standard errors are estimated using Taylor linearization.

Variable	With Cortisol N=2485		Without Cortisol N=7589		P-value (2-sided)
	Mean	SE	Mean	SE	
Female, %	49.46	0.97	51.61	0.60	0.065
Age, y	15.153	0.036	15.186	0.032	0.248
Race/ethnicity, %					0.710
Hispanic	18.87	1.16	18.75	0.83	
Black	18.71	1.25	19.48	0.95	
Other	6.52	0.57	6.01	0.34	
White	55.90	1.54	55.76	1.173	
Urbanicity, %					0.001
Non-urban	23.18	2.20	22.73	1.71	
Suburb	35.33	1.89	31.93	1.46	
Urban center	41.49	1.88	45.34	1.53	
Region, %					<0.001
Northeast	16.42	1.43	18.94	1.20	
Midwest	25.15	1.80	28.32	1.50	
South	36.78	2.04	33.05	1.53	
West	21.65	1.48	19.70	1.14	
Household income (log), dollars	11.106	0.026	11.188	0.0167	0.005
Maternal age at birth, y	26.034	0.128	26.049	0.086	0.463
Maternal level of education, %					0.012
Less than high school	10.78	1.10	8.79	0.45	
High school graduate	43.53	1.12	43.66	0.69	
Some college	24.00	1.02	23.95	0.60	
College graduate	21.69	1.06	23.59	0.64	
Maternal work history, %					0.461
All of adolescent's life	48.31	1.05	49.53	0.66	
Most of adolescent's life	21.94	0.84	20.73	0.46	
Some of adolescent's life	14.98	0.73	14.15	0.43	
A little of adolescent's life	7.09	0.54	7.41	0.32	
Not at all	7.68	0.57	8.17	0.35	

Continued on next page

Table 1 – continued from previous page

Variable	With Cortisol		Without Cortisol		P-value
Paternal work history, %					0.867
All of adolescent's life	77.29	1.05	76.72	0.64	
Most of adolescent's life	13.03	0.83	13.71	0.44	
Some of adolescent's life	6.20	0.62	5.99	0.33	
A little of adolescent's life	2.16	0.37	2.08	0.24	
Not at all	1.32	0.29	1.49	0.19	
Parental current employment, %	72.91	4.57	75.08	0.81	0.033
Family structure, %					
Lived with mother whole life	87.70	0.68	86.83	0.42	0.276
Lived with father whole life	57.20	1.12	56.16	0.74	0.378
Citizen, %	95.90	0.44	95.63	0.27	0.604
English as second language, %	20.60	1.09	19.86	0.77	0.437
Immigrant generation, %					0.519
1st	5.98	0.56	5.88	0.34	
2nd	12.27	0.80	13.16	0.55	
3rd or greater	81.74	1.02	80.96	0.73	
Small for gestational age, %	6.45	0.67	5.33	0.42	0.040
Current smoker, %	5.72	0.48	7.29	0.35	0.009
Current drug user, %	5.51	0.47	6.01	0.31	0.389
Current oral contraceptive user, %	3.66	0.37	4.59	0.27	0.057
No. Rx	0.4348	0.020	0.4559	0.012	0.188
Typical bedtime,hr					
Weekday	00:22	00:02	00:19	00:02	0.617
Weekend	22:26	00:02	22:25	00:01	0.850
Typical hours of sleep,hr					
Weekday	7.672	0.030	7.676	0.018	0.460
Weekend	8.845	0.044	8.851	0.027	0.454
Physical abuse by parent, %	12.30	0.69	12.74	0.45	0.594
Three or more parental adversities, %	3.70	0.39	3.83	0.24	0.811
Disadvantaged neighborhood residence, %	38.07	2.02	35.37	1.53	0.016
Cortisol sample measurements					
Season, %					<0.001
Spring	10.54	0.89	27.54	0.89	
Summer	42.05	1.32	27.99	0.80	
Fall	33.08	1.24	24.42	0.87	
Winter	14.33	0.87	20.06	0.71	
Weekend, %	29.18	0.97	29.62	0.64	0.690
Collection time, hr	14:52	00:04	15:02	00:02	<0.001

Table 2: NCS-A cortisol sample characteristics by CAR sampling time. Results are combined across imputations and survey design-based standard errors are estimated using Taylor linearization.

Variable	During CAR N=449		Post-CAR N=2036		P-value (2-sided)
	Mean	SE	Mean	SE	
Female, %	47.66	2.33	49.85	1.07	0.430
Age, y	15.116	0.073	15.161	0.038	0.290
Race/ethnicity, %					0.497
Hispanic	18.49	2.07	18.96	1.19	
Black	20.71	2.17	18.27	1.31	
Other	7.35	1.23	6.34	0.62	
White	53.45	2.61	56.43	1.61	
Urbanicity, %					0.063
Urban center	22.72	2.88	23.28	2.24	
Suburb	31.18	2.70	36.25	1.98	
Non-urban	46.10	2.92	40.47	1.92	
Region, %					0.705
Northeast	16.48	2.16	16.40	1.47	
Midwest	26.73	2.55	24.80	1.87	
South	34.52	2.96	37.28	2.10	
West	22.27	2.30	21.51	1.53	
Household income (log), dollars	11.135	0.052	11.100	0.028	0.724
Maternal age at birth, y	26.109	0.281	26.018	0.140	0.614
Maternal level of education, %					0.575
Less than high school	9.29	1.87	11.11	1.22	
High school graduate	43.83	2.95	43.46	1.19	
Some college	25.81	2.33	23.61	1.13	
College graduate	21.07	2.11	21.83	1.17	
Maternal work history, %					0.729
All of adolescent's life	51.29	2.42	47.65	1.16	
Most of adolescent's life	20.96	2.08	22.16	0.93	
Some of adolescent's life	13.81	1.63	15.24	0.82	
A little of adolescent's life	6.84	1.21	7.14	0.59	
Not at all	7.10	1.22	7.81	0.65	
Paternal work history, %					0.942
All of adolescent's life	76.61	2.42	77.44	1.12	
Most of adolescent's life	13.07	1.77	13.03	0.89	
Some of adolescent's life	6.19	1.28	6.20	0.67	
A little of adolescent's life	2.67	0.96	2.04	0.40	
Not at all	1.45	0.72	1.30	0.29	
Parental current employment, %	69.24	5.58	73.71	4.50	0.061
Family structure, %					
Lived with mother whole life	87.53	1.59	87.74	0.75	0.964
Lived with father whole life	61.51	2.32	56.25	1.24	0.047
Citizen, %	94.88	1.07	96.12	0.50	0.285
English as second language, %	20.94	2.15	20.53	1.13	0.898
Immigrant generation, %					0.858

Continued on next page

Table 2 – continued from previous page

Variable	During CAR		Post-CAR		P-value
1st	6.50	1.27	5.87	0.62	
2nd	11.92	1.61	12.35	0.88	
3rd or greater	81.58	2.03	81.78	1.08	
Small for gestational age, %	6.50	1.63	6.44	0.67	1.000
Current smoker, %	4.23	0.95	6.05	0.54	0.164
Current drug user, %	4.01	0.92	5.84	0.54	0.153
Current oral contraceptive user, %	4.90	1.01	3.39	0.39	0.160
No. Rx	0.452	0.046	0.431	0.022	0.663
Typical bedtime,hr					
Weekday	22:42	00:04	22:44	00:02	0.427
Weekend	00:13	00:05	00:24	00:02	0.023
Typical hours of sleep, hr					
Weekday	7.770	0.071	7.650	0.032	0.939
Weekend	8.868	0.102	8.839	0.047	0.602
Physical abuse by parent, %	10.47	1.54	12.71	0.75	0.220
Three or more parental adversities, %	2.00	0.66	4.08	0.45	0.049
Disadvantaged neighborhood residence, %	38.53	3.00	37.97	2.07	0.866
Cortisol sample measurements					
Season, %					<0.001
Spring	7.80	1.36	11.15	1.00	
Summer	57.46	2.47	38.65	1.40	
Fall	24.72	2.21	34.92	1.33	
Winter	10.02	1.46	15.28	0.94	
Weekend, %	56.12	2.47	23.23	0.98	<0.001
Collection time, hr	10:12	00:03	15:54	00:04	<0.001

Table 3: Conditional expected ratios in cortisol levels and conditional expected differences in slope (ng/mL/hr  $10^{-2}$ ) during the late decline portion of cortisol’s circadian rhythm comparing adolescents living in disadvantaged versus non-disadvantaged neighborhoods under different exclusion criteria.

<b>Model</b>	<b>Pre</b> Mean (95% CI)	<b>Post</b> Mean (95% CI)	<b>Rate</b> Mean (95% CI)
<b>Current smokers and drug users excluded</b>			
Unadjusted	1.07 (1.00, 1.15)	1.01 (0.93, 1.09)	-0.75 (-1.60, 0.11)
Model 1	1.19 (1.05, 1.34)	0.96 (0.85, 1.07)	-2.47 (-4.13, -0.81)
Model 2	1.15 (1.00, 1.31)	0.96 (0.86, 1.07)	-2.38 (-4.14, -0.61)
Model 3	1.13 (0.99, 1.28)	0.95 (0.85, 1.06)	-2.20 (-3.87, -0.52)
<b>Current smokers excluded, current drug users included</b>			
Unadjusted	1.07 (1.00, 1.15)	1.00 (0.92, 1.09)	-0.78 (-1.59, 0.03)
Model 1	1.16 (1.01, 1.33)	0.94 (0.84, 1.07)	-2.30 (-3.89, -0.72)
Model 2	1.13 (0.97, 1.32)	0.95 (0.85, 1.06)	-2.21 (-3.95, -0.47)
Model 3	1.11 (0.95, 1.28)	0.94 (0.84, 1.05)	-2.03 (-3.68, -0.38)
<b>Current smokers and drug users included</b>			
Unadjusted	1.06 (1.00, 1.13)	1.02 (0.94, 1.11)	-0.56 (-1.29, 0.18)
Model 1	1.11 (0.96, 1.27)	0.96 (0.84, 1.10)	-1.77 (-3.36, -0.18)
Model 2	1.08 (0.92, 1.26)	0.97 (0.86, 1.10)	-1.62 (-3.34, 0.10)
Model 3	1.06 (0.92, 1.23)	0.96 (0.86, 1.08)	-1.44 (-3.14, 0.27)

**Sensitivity Analysis for an Unobserved Confounder** This section presents estimates of the influence of an unobserved confounder. We used a bias equation described in VanderWeele and Arah for average effect differences for those with versus without the exposure, conditional on a vector of confounding variables,  $\mathbf{X}$ . We made the following three simplifying assumptions as discussed by VanderWeele and Arah: (1) the association between the outcome and unobserved confounder is consistent across levels of exposure and observed covariates; (2) the unobserved confounder is binary; and (3) the difference in the prevalence of the unobserved confounder in the exposed versus unexposed is constant across levels of the covariates. Let  $A$  denote the exposure received by an adolescent. In this study,  $a1$  represents residence in a disadvantaged neighborhood and  $a0$  represents residence in a non-disadvantaged neighborhood. Let  $Y$  denote the observed outcome, cortisol rate of change. Let  $\mathbf{X}$  denote the observed covariates, and let  $U$  denote the unobserved binary confounder.

Under the above three simplifying assumptions, the bias of the estimated effect is:

$$d(x) = \delta\gamma$$

where

$$\delta = P(U = 1|a1, \mathbf{X}) - P(U = 1|a0, \mathbf{X}) \text{ and } \gamma = E(Y|a, \mathbf{X}, U = 1) - E(Y|a, \mathbf{X}, U = 0)$$

We calculated the bias and resulting corrected lower 95% confidence bound across an array of input parameter values. We allowed  $\gamma$  to range from 0 to 0.18. We allowed  $\delta$ , the difference in prevalence of the unobserved confounder between exposed and unexposed groups, to range from 5 to 25%.

Figure 1, below, plots the corrected lower 95% CI bound (on the y-axis) against the value of  $\gamma$  (on the x-axis). The different colored curves in each subplot show the relationship for different values of  $\delta$ . Each of the three subplots corresponds to the three adjusted models used in the study (see Figure 2 in the manuscript text). For Adjusted Model 1 and setting  $\delta=0.2$ ,  $\gamma$  would have to be at least 0.04 to render our estimate of the average difference in cortisol slope between disadvantaged and nondisadvantaged neighborhoods nonsignificant. Put another way, the presence of an unobserved confounder would have to change the conditional mean

cortisol slope by 98% to render the effect non-significant.

Including possible mediators in the model makes the effect estimate more sensitive to an unobserved confounder. For example, in Adjusted Models 2 and 3,  $\gamma$  would need to be greater than 0.03 and 0.026 (an increase of 74% and 64% over the conditional mean cortisol slope), respectively.

Figure 1: Corrected lower 95% confidence bound by values of  $\delta$  and  $\gamma$

