Online Supplement

**Impact of the COVID-19 pandemic on children's sleep habits: an ECHO study**

Supplement Table 1. Maternal Education Attainment by Racial & Ethnic Group

| | High school degree, GED or equivalent or less | Some college, no degree | Bachelor's degree | Master's degree or higher | Missing | Total |
|---|---|---|---|---|---|---|
| **Non-Hispanic White** | <25 (45.5%) | 53 (36.3%) | 108 (65.5%) | 108 (67.9%) | <5 | 297 |
| **Non-Hispanic Black** | 5 (9.3%) | 24 (16.4%) | 7 (4.2%) | 8 (5.0%) | 0 | 44 |
| **Non-Hispanic Other** | 14 (25.9%) | 24 (16.4%) | 20 (12.1%) | 22 (13.8%) | 0 | 80 |
| **Hispanic all races** | 11 (20.4%) | <45 (30.8%) | 30 (18.2%) | 21 (13.2%) | 0 | <110 |
| **Missing** | 0 | <5 | 0 | 0 | 0 | <5 |
| **Total** | <55 | 146 | 165 | 159 | <5 | 528 |

Supplement Table 2. Sleep duration (hours)

| | Model 1 | Model 2 | Full Model |
|---|---|---|---|
| **N of children** | 334 | 334 | 333 |
| **Time point** | | | |
| **Pandemic 1** | 0.05 (-0.13, 0.23) | 0.07 (-0.12, 0.25) | 0.09 (-0.08, 0.26) |
| **Pandemic 2** | 0.12 (-0.08, 0.33) | 0.14 (-0.07, 0.35) | 0.16 (-0.03, 0.35) |
| **Age, yrs old** | -0.14** (-0.21, -0.07) | -0.16** (-0.23, -0.08) | -0.17** (-0.22, -0.11) |
| **Male** | -0.05 (-0.27, 0.16) | -0.08 (-0.29, 0.13) | -0.07 (-0.28, 0.14) |
| **Race & Ethnicity** | | | |
| Non-Hispanic White, n (%) | REF | REF | REF |
| Hispanic all races, n (%) | | -0.32* (-0.60, -0.04) | -0.19 (-0.47, 0.09) |
| Non-Hispanic Black, n (%) | | -0.91** (-1.35, -0.48) | -0.77** (-1.20, -0.33) |
| Non-Hispanic other , n (%) | | -0.23 (-0.53, 0.08) | -0.16 (-0.46, 0.14) |
| **Maternal Education, n (%) [1]** | | | |
| Master's degree or higher | REF | REF | REF |
| Bachelor's degree | | | -0.17 (-0.44, 0.09) |
| Some college, no degree | | | -0.45** (-0.73, -0.16) |
| High school degree, GED or less | | | -0.35 (-0.77, 0.07) |

1. *p<0.05; **p<0.01; ***p<0.001

2. Beta coefficients from linear mixed effects models that include cohort and child as random intercepts to adjust for the within cohort and within child correlations. Maximum Likelihood method was used to fit model. P-values were given from LMEM t-test. The analysis was conducted using the R package "lme4".

3. The reference group is the pre-pandemic period: July 1, 2019- March 15, 2020. Pandemic data collection period 1 is December 1, 2020 – April 30, 2021, and pandemic period 2 is May 1, 2021 – August 31, 2021.

Supplement Table 3. Sleep Latency

| | Model 1 | Model 2 | Full Model |
|---|---|---|---|
| **N of children** | 152 | 152 | 152 |
| **Time point** | | | |
| Pandemic 1 | 6.61** (2.68, 10.54) | 6.40** (2.44, 10.36) | 6.02** (2.09, 9.94) |
| Pandemic 2 | 1.71 (-2.65, 6.06) | 1.45 (-2.94, 5.84) | 0.92 (-3.44, 5.28) |
| **Age, yrs old** | -0.28 (-2.11, 1.55) | -0.11 (-1.97, 1.76) | 0.24 (-1.59, 2.08) |
| **Male** | 3.39 (-0.97, 7.76) | 3.55 (-0.84, 7.95) | 3.77 (-0.52, 8.06) |
| **Race & Ethnicity** | | | |
| Non-Hispanic White, n (%) | REF | REF | REF |
| Hispanic all races, n (%) | | 1.58 (-3.86, 7.02) | -0.07 (-5.77, 5.64) |
| Non-Hispanic Black, n (%) | | 2.60 (-7.07, 12.27) | -1.78 (-11.65, 8.09) |
| Non-Hispanic other , n (%) | | 2.13 (-4.35, 8.61) | 1.86 (-4.58, 8.30) |
| **Maternal Education, n (%) [1]** | | | |
| Master's degree or higher | REF | REF | REF |
| Bachelor's degree | | | 0.82 (-4.81, 6.44) |
| Some college, no degree | | | 7.74* (1.71, 13.77) |
| High school degree, GED or less | | | -2.39 (-11.86, 7.07) |

1. *p<0.05; **p<0.01; ***p<0.001

2. Beta coefficients from linear mixed effects models that include cohort and child as random intercepts to adjust for the within cohort and within child correlations. Maximum Likelihood method was used to fit model. P-values were given from LMEM t-test. The analysis was conducted using the R package "lme4".

3. The reference group is the pre-pandemic period: July 1, 2019- March 15, 2020. Pandemic data collection period 1 is December 1, 2020 – April 30, 2021, and pandemic period 2 is May 1, 2021 – August 31, 2021.

Supplement Table 4. Weekday Sleep Midpoint

| | Model 1 | Model 2 | Full Model |
|---|---|---|---|
| **N of children** | 312 | 312 | 308 |
| **Time point** | | | |
| Pandemic 1 | 11.78** (6.87, 16.69) | 10.86** (5.93, 15.79) | 11.10** (6.21, 15.98) |
| Pandemic 2 | 17.57** (11.81, 23.34) | 16.67** (10.89, 22.44) | 16.68** (11.00, 22.35) |
| **Age, yrs old** | 2.13 (-0.32, 4.58) | 2.87* (0.40, 5.34) | 2.95* (0.58, 5.31) |
| **Male** | -2.05 (-9.13, 5.02) | -1.68 (-8.52, 5.17) | -1.72 (-8.56, 5.12) |
| **Race & Ethnicity** | | | |
| Non-Hispanic White, n (%) | REF | REF | REF |
| Hispanic all races, n (%) | | 15.34** (6.19, 24.49) | 11.69* (2.26, 21.13) |
| Non-Hispanic Black, n (%) | | 23.13** (9.67, 36.59) | 18.46** (4.71, 32.22) |
| Non-Hispanic other , n (%) | | 13.80** (4.04, 23.55) | 11.73* (1.92, 21.55) |
| **Maternal Education, n (%) [1]** | | | |
| Master's degree or higher | REF | REF | REF |
| Bachelor's degree | | | 3.60 (-5.24, 12.44) |
| Some college, no degree | | | 11.48* (2.00, 20.96) |
| High school degree, GED or less | | | 8.68 (-4.94, 22.29) |

1. *p<0.05; **p<0.01; ***p<0.001

2. Beta coefficients from linear mixed effects models that include cohort and child as random intercepts to adjust for the within cohort and within child correlations. Maximum Likelihood method was used to fit model. P-values were given from LMEM t-test. The analysis was conducted using the R package "lme4".

3. The reference group is the pre-pandemic period: July 1, 2019- March 15, 2020. Pandemic data collection period 1 is December 1, 2020 – April 30, 2021, and pandemic period 2 is May 1, 2021 – August 31, 2021.

4. The midpoint weekday sleep outcome is measured modelled as minutes from 12:00:00 AM.

Supplement Table 5. Weekend Sleep Midpoint

|  | Model 1 | Model 2 | Full Model |
|---|---|---|---|
| **N of children** | 296 | 296 | 292 |
| **Time point** | | | |
| Pandemic 1 | 10.13** (3.91, 16.35) | 6.87* (0.36, 13.39) | 6.68* (0.92, 12.43) |
| Pandemic 2 | 10.50** (3.03, 17.96) | 6.41 (-1.43, 14.24) | 5.97 (-0.80, 12.75) |
| **Age, yrs old** | 4.84** (1.37, 8.31) | 7.52** (3.72, 11.33) | 8.05** (5.23, 10.86) |
| **Male** | -9.33 (-21.35, 2.69) | -5.54 (-16.59, 5.50) | -5.72 (-16.55, 5.10) |
| **Race & Ethnicity** | | | |
| Non-Hispanic White, n (%) | REF | REF | REF |
| Hispanic all races, n (%) | | 42.27** (27.97, 56.57) | 32.97** (18.64, 47.31) |
| Non-Hispanic Black, n (%) | | 69.45** (46.32, 92.58) | 58.81** (35.59, 82.02) |
| Non-Hispanic other , n (%) | | 30.47** (14.52, 46.43) | 25.82** (10.21, 41.44) |
| **Maternal Education, n (%) [1]** | | | |
| Master's degree or higher | REF | REF | REF |
| Bachelor's degree | | | 7.08 (-6.62, 20.78) |
| Some college, no degree | | | 30.66** (15.70, 45.62) |
| High school degree, GED or less | | | 32.10** (12.24, 51.96) |

1. *p<0.05; **p<0.01; ***p<0.001

2. Beta coefficients from linear mixed effects models that include cohort and child as random intercepts to adjust for the within cohort and within child correlations. Maximum Likelihood method was used to fit model. P-values were given from LMEM t-test. The analysis was conducted using the R package "lme4".

3. The reference group is the pre-pandemic period: July 1, 2019- March 15, 2020. Pandemic data collection period 1 is December 1, 2020 – April 30, 2021, and pandemic period 2 is May 1, 2021 – August 31, 2021.

4. The midpoint weekday sleep outcome is measured modelled as minutes from 12:00:00 AM.

Supplement Table 6. Frequency of delayed bedtime

| | Model 1 | Model 2 | Full Model |
|---|---|---|---|
| **N of children** | 309 | 309 | 309 |
| **Time point** | | | |
| Pandemic 1 | 1.19 (0.82,1.74) | 1.22 (0.84,1.78) | 1.21 (0.82,1.77) |
| Pandemic 2 | 1.00 (0.65,1.51) | 1.01 (0.67,1.54) | 1.00 (0.66,1.53) |
| **Age, yrs old** | 0.93 (0.84,1.04) | 0.92 (0.83,1.02) | 0.92 (0.82,1.03) |
| **Male** | 1.62 (0.99,2.64) | 1.57 (0.96,2.57) | 1.57 (0.96,2.55) |
| **Race & Ethnicity** | | | |
| Non-Hispanic White, n (%) | REF | REF | REF |
| Hispanic all races, n (%) | | 0.81 (0.43,1.51) | 0.82 (0.43,1.56) |
| Non-Hispanic Black, n (%) | | 0.86 (0.35,2.12) | 0.85 (0.34,2.16) |
| Non-Hispanic other , n (%) | | 0.54 (0.27,1.09) | 0.56 (0.28,1.13) |
| **Maternal Education, n (%) [1]** | | | |
| Master's degree or higher | REF | REF | REF |
| Bachelor's degree | | | 1.98* (1.08,3.64) |
| Some college, no degree | | | 1.40 (0.73,2.68) |
| High school degree, GED or less | | | 0.86 (0.30,2.40) |

1. *p<0.05; **p<0.01; ***p<0.001

2. Odds ratios estimating the odds of reporting a higher category of the outcome from Cumulative link mixed models fitted with the Laplace approximation. We include cohort and child as random intercepts to account for within cohort and within child correlations. P-values were given from LMEM Wald test. The analysis was conducted by the R package "ordinal".

3. The reference group is the pre-pandemic period: July 1, 2019- March 15, 2020. Pandemic data collection period 1 is December 1, 2020 – April 30, 2021, and pandemic period 2 is May 1, 2021 – August 31, 2021.

4. In the past 7 days, I/my child "put-off" or delayed bedtime. Never/almost never, sometimes, almost always/always.

Supplement Table 7. Daytime nap frequency

| | Model 1 | Model 2 | Full Model |
|---|---|---|---|
| **N of children** | 345 | 345 | 341 |
| **Time point** | | | |
| Pandemic 1 | 0.27*** (0.18,0.42) | 0.26*** (0.17,0.40) | 0.26*** (0.17,0.40) |
| Pandemic 2 | 0.35*** (0.22,0.57) | 0.35*** (0.21,0.56) | 0.35*** (0.21,0.56) |
| **Age, yrs old** | 0.67*** (0.60,0.75) | 0.70*** (0.62,0.78) | 0.71*** (0.63,0.79) |
| **Male** | 1.13 (0.71,1.82) | 1.21 (0.76,1.93) | 1.24 (0.78,1.98) |
| **Race & Ethnicity** | | | |
| Non-Hispanic White, n (%) | REF | REF | REF |
| Hispanic all races, n (%) | | 2.24** (1.24,4.05) | 2.09* (1.14,3.83) |
| Non-Hispanic Black, n (%) | | 5.23*** (2.4,11.41) | 4.49*** (2.00,10.09) |
| Non-Hispanic other , n (%) | | 0.98 (0.49,1.93 | 0.95 (0.48,1.89) |
| **Maternal Education, n (%) [1]** | | | |
| Master's degree or higher | REF | REF | REF |
| Bachelor's degree | | | 1.15 (0.62,2.16) |
| Some college, no degree | | | 1.57 (0.83,2.94) |
| High school degree, GED or less | | | 1.36 (0.60,3.08) |

1. *p<0.05; **p<0.01; ***p<0.001

2. Odds ratios estimating the odds of reporting a higher category of the outcome from Cumulative link mixed models fitted with the Laplace approximation. We include cohort and child as random intercepts to account for within cohort and within child correlations. P-values were given from LMEM Wald test. The analysis was conducted by the R package "ordinal".

3. The reference group is the pre-pandemic period: July 1, 2019- March 15, 2020. Pandemic data collection period 1 is December 1, 2020 – April 30, 2021, and pandemic period 2 is May 1, 2021 – August 31, 2021.

4. In the past 7 days, I/my child "put-off" or delayed bedtime. Never/almost never, sometimes, almost always/always.

5. How many days did you/your child take a daytime nap? None, 1-3 days, or 4-7 days.