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Title: Non-Pharmacological Interventions to Lengthen Sleep Duration in Healthy Children

A Systematic Review and Meta-Analysis

Sub-title: Interventions to Lengthen Sleep Duration in Healthy Children

Online Supplementary Materials:

eTable 1: Search strategy used in Medline

eTable 2: Detailed table of study characteristics

eTable 3: Spreadsheet of study estimates used

eTable 1: Search strategy used in Medline

Ovid MEDLINE(R) ALL <1946 to November 04, 2019>

- 1 exp Child/
- 2 exp Pediatrics/
- 3 exp adolescent/
- 4 (paediatric\$ or pediatric\$ or child\$ or adolescen\$ or juvenile\$ or youth\$ or teen\$ or minor\$ or pubescen\$ or prepubescen\$ or boy\$ or girl\$).tw.
- 5 or/1-4
- 6 (sleep\$ adj5 (duration or quality or pattern\$ or improv\$ or increas\$)).tw.
- 7 exp Sleep/ and (duration or quality or pattern\$ or improv\$ or increas\$).tw.
- 8 sleep hygiene/
- 9 (bedtime\$ or bed time\$).tw.
- 10 time in bed.tw.
- 11 sleep time\$.tw.
- 12 or/6-11
- 13 (controlled clinical trial or randomized controlled trial).pt.
- 14 (randomized or randomised).ab,ti.
- 15 placebo.ab,ti.
- 16 dt.fs.
- 17 randomly.ab,ti.
- 18 trial.ab,ti.
- 19 groups.ab,ti.
- 20 or/13-19
- 21 Animals/
- 22 Humans/
- 23 21 not (21 and 22)
- 24 20 not 23
- 25 5 and 12 and 24

Embase <1974 to 2019 Week 44>

- 1 exp Child/
- 2 exp Pediatrics/
- 3 exp adolescent/

4 (paediatric\$ or pediatric\$ or child\$ or adolescen\$ or juvenile\$ or youth\$ or teen\$ or minor\$ or pubescen\$ or prepubescen\$ or boy\$ or girl\$).tw.

5 or/1-4

6 (sleep\$ adj5 (duration or quality or pattern\$ or improv\$ or increas\$)).tw.

7 exp Sleep/ and (duration or quality or pattern\$ or improv\$ or increas\$).tw.

8 sleep parameters/ or sleep pattern/ or sleep quality/ or sleep time/

9 sleep hygiene/

10 (bedtime\$ or bed time\$).tw.

11 time in bed.tw.

12 sleep time\$.tw.

13 or/6-12

14 5 and 13

15 Randomized Controlled Trial/

16 randomization/

17 controlled clinical trial/

18 Double Blind Procedure/

19 Single Blind Procedure/

20 Crossover Procedure/

21 (clinica\$ adj3 trial\$).tw.

22 ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj3 (mask\$ or blind\$ or method\$)).tw.

23 exp Placebo/

24 placebo\$.ti,ab.

25 random\$.ti,ab.

26 ((control\$ or prospectiv\$) adj3 (trial\$ or method\$ or stud\$)).tw.

27 (crossover\$ or cross-over\$).ti,ab.

28 or/15-27

29 exp animals/ or exp invertebrate/ or animal experiment/ or animal model/ or animal tissue/ or animal cell/ or nonhuman/

30 human/ or normal human/ or human cell/

31 29 and 30

32 29 not 31

33 28 not 32

34 14 and 33

PsycINFO <1967 to October Week 4 2019>

- 1 exp PEDIATRICS/
- 2 (paediatric\$ or pediatric\$ or child\$ or adolescen\$ or juvenile\$ or youth\$ or teen\$ or minor\$ or pubescen\$ or prepubescen\$ or boy\$ or girl\$).tw.
- 3 1 or 2
- 4 (sleep\$ adj5 (duration or quality or pattern\$ or improv\$ or increas\$)).tw.
- 5 exp Sleep/ and (duration or quality or pattern\$ or improv\$ or increas\$).tw.
- 6 (bedtime\$ or bed time\$).tw.
- 7 time in bed.tw.
- 8 sleep time\$.tw.
- 9 or/4-8
- 10 3 and 9
- 11 random\$.tw.
- 12 (clinical adj5 trial\$).tw.
- 13 (control\$ adj5 trial\$).tw.
- 14 ((clinical or control\$ or comparativ\$) adj5 (study or studies)).tw.
- 15 placebo\$.tw.
- 16 (single blind\$ or single-blind\$).tw.
- 17 (double blind\$ or double-blind\$).tw.
- 18 (triple blind\$ or triple-blind\$).tw.
- 19 or/11-18
- 20 10 and 19

CENTRAL (The Cochrane Library Issue 10, 2019)

- #1 MeSH DESCRIPTOR Child Explode All AND CENTRAL:TARGET
- #2 MeSH DESCRIPTOR Pediatrics Explode All AND CENTRAL:TARGET
- #3 MeSH DESCRIPTOR Adolescent AND CENTRAL:TARGET
- #4 paediatric* or pediatric* or child* or adolescen* or juvenile* or youth* or teen* or minor* or pubescen* or prepubescen* AND CENTRAL:TARGET
- #5 {OR #1-#4}
- #6 (sleep* NEAR5 (duration or quality or pattern* or improve* or increase*)) AND CENTRAL:TARGET

- #7 MESH DESCRIPTOR Sleep EXPLODE ALL AND CENTRAL:TARGET
- #8 #7 AND (duration or quality or pattern* or improve* or increase*)
- #9 #6 OR #8
- #10 #5 AND #9

Web of Science Core Collection

- #1 TS=(paediatric* or pediatric* or child* or adolescen* or juvenile* or youth* or teen* or minor* or pubescen* or prepubescen*) OR TI=(paediatric* or pediatric* or child* or adolescen* or juvenile* or youth* or teen* or minor* or pubescen* or prepubescen*)
- #2 TS=(sleep* NEAR (duration or quality or pattern* or improve* or increase*)) OR TI=(sleep* NEAR (duration or quality or pattern* or improve* or increase*))
- #3 TS=(random* or placebo* or trial* or groups) OR TI=(random* or placebo* or trial* or groups)
- #4 #3 AND #2 AND #1

ClinicalTrials.gov

Study type: interventional

Outcome measures: sleep duration

Limits: Child

WHO Trials Registry (<https://trialsearch.who.int/>)

Search terms: sleep duration

Limits: Trials in children

eTable 2: Detailed table of study characteristics

[illegible]

[illegible]

^aMoore 2019 HC refers to the Moore 2019 Healthy Change arm (compared with half the control group). Similarly, Moore 2019 SC refers to the Moore 2019 System Change arm (compared with half the control group).

^bTheory based intervention was defined as per the framework outlined by Painter et al ³⁴. A study was identified as involving physical activity if they performed exercise with the participants directly as part of the intervention. N means data not available

eTable 3: Spreadsheet of study estimates used

Study name (citation)	Published sleep duration at follow-up (minutes)						Effect estimates (minutes)				
	Intervention group			Control group			Intervention Effect	Standard Error	Confidence interval		Estimation method
	Mean	SD	Total	Mean	SD	Total			Lower	Upper	
Beijamini 2012 ⁵¹	411	67	10	422	50	11	-11.00	26.00	-61.97	39.97	1
Blake 2016 ⁵²	427.34	38.46	63	416.85	34.55	60	-3.97	5.72	-15.18	7.25	2
Bovi 2021 ⁵³			18			4	-20.69	60.13	-138.56	97.17	2
Bovi 2021 contrast 1	-34.8	99	9	0	0	2					
Bovi 2021 contrast 2	70.8	90	9	79.8	91.2	2					
Cain 2011 ⁵⁴	461.4	60	53	466.2	54	47	-4.80	11.40	-27.14	17.54	1
Cepni 2021 ⁵⁵	6.9		24	-18.2		26	-5.60	7.23	-19.80	8.53	2
Dewald-Kaufmann 2013 ⁴¹	429	36	28	409	42	27	22.80	9.60	3.98	41.62	2
Dong 2019 ⁵⁶	436.63	58.15	89	430.57	60.63	87	-0.75	11.62	-23.52	22.02	2
Haines 2013 ⁵⁷	33.6	96	55	-11.4	120	56	45.00	21.12	3.60	86.40	2
Hammersley 2019 ⁵⁸	572.4	38.4	21	586.8	57.6	20	-33.00	15.00	-60.60	-1.80	2
Hammersley 2021 ⁵⁹			159			81	-6.00	7.13	-19.98	7.98	2
Hammersley contrast1	661.8	60.6	73	673.8	54.6	81	-6.00	10.10	-25.80	13.80	
Hammersley contrast2	664.8	51.6	86	673.8	54.6	81	-6.00	10.10	-25.80	13.80	
Hart 2017 ⁴³	35	28	38	-9	39	38	44.00	7.79	28.74	59.26	2
Hiscock 2019 ⁶¹	624.1	43.9	140	627.1	44.2	157	-0.80	3.85	-8.30	6.80	2
Kalak 2012 ⁶²	434.89	45.1	27	406	56	24	28.89	14.35	0.76	57.02	1
Kira 2014 ⁶³	541	67	15	524	49	14	17.00	21.70	-25.53	59.53	1
Knebel 2020 ⁶⁴			351			246	-3.00	9.95	-22.80	16.20	2
Lin 2018 ⁶⁵	447	8.4	1385	391.2	12	1386	28.80	1.80	25.27	32.33	2
Lufi 2011 ⁴⁵	451	19	26	438	19	21	13.00	5.57	2.07	23.93	1
Marsh 2020 ⁶⁶	660	36	25	636	72	26	24.00	15.85	-7.07	55.07	1
Mindell 2009 ⁶⁷	612	51	133	612	52.2	67	0.00	8.43	-16.53	16.53	1
Mindell 2016 ⁶⁸	611.4	73.2	56	593.4	58.2	53	18.00	12.63	-6.76	42.76	1
Mitchell 2021 Study 1 ⁶⁹			14			8	26.53	11.96	3.09	49.96	2
Mitchell 2021 Study1 GF	510.6		6	489.6		4	33.00		-0.60	66.60	
Mitchell 2021 Study 1LF	523.6		8	489.6		4	20.40		-12.00	53.40	
Mitchell 2021 Study 2 ⁶⁹			28			9	-9.40	10.14	-11.09	29.11	2

Study name (citation)	Published sleep duration at follow-up (minutes)						Effect estimates (minutes)				
	Intervention group			Control group			Intervention Effect	Standard Error	Confidence interval		Estimation method
	Mean	SD	Total	Mean	SD	Total			Lower	Upper	
Mitchell Study2 LF			11			3	-13.20		-48.60	22.20	
Mitchell Study 2 LF + NFB			11			3	-13.80		-51.60	0.41	
Mitchell Study 2 NFB			11			3	-3.60		-34.80	27.00	
Moore 2019 Healthy Change ⁷⁰			118			60	0.23	3.83	-7.27	7.73	2
Moore 2019 System Change ⁷⁰			123			59	2.95	3.03	-2.99	8.88	2
Morell-Azanza 2019 ⁷¹	526.42	72.53	79	516.62	141.58	27	9.80	28.44	-45.95	65.55	1
Moseley 2009 ⁷²	464.4	60	34	465.6	42	32	-1.20	12.69	-26.07	23.67	1
Moula 2020 ⁷³	489.79	46.02	28	464.4	71.6	28	25.39	16.09	-6.14	56.92	2
Mousarrezai 2020 ⁷⁴	564.86	35.44	47	528.96	52.2	45	29.14	8.44	12.59	45.69	2
Pablos 2018 ⁷⁵	570	42	82	582	42	76	-0.66	6.69	-13.20	12.00	2
Puder 2011 ⁷⁶	654	35.1289	333	653.88	35.1289	292	0.12	2.82	-5.40	5.64	2
Quach 2018 ⁷⁷	631.2	39.6	205	630	54	205	1.20	4.68	-7.97	10.37	1
Rigney 2015 ⁷⁸	475	60	88	474	64	87	1.00	9.38	-17.39	19.39	1
Santiago 2020 ⁷⁹	414	12	18	408	6	12	6.00	3.32	-0.50	12.50	1
Sousa 2013 ⁸⁰	436	73	18	425	95	16	11.00	29.33	-46.48	68.48	1
Sundgot-Borgen 2019 ⁸¹			615			284	14.20	4.94	4.52	23.88	2
Sundot Borgen 2019 Boys Weekday	411	70.2069	182	384	72.81066	87	27.60	9.49	9.00	46.20	
Sundot Borgen 2019 Girls Weekday	406.8	63.69996	433	397.8	68.74613	197	9.00	5.82	-2.40	20.40	
Tamura 2014 ⁸²			72			76	13.77	6.87	0.31	27.24	1
Tamura 2014 Grade 4 Boys	522	51.3	13	514	15.5	15	8.00	14.78	-20.97	36.97	
Tamura 2014 Grade 4 Girls	526	19.8	13	512	39	11	14.00	12.98	-11.44	39.44	
Tamura 2014 Grade 5 Boys	483	57.4	10	477	36.6	11	6.00	21.24	-35.64	47.64	
Tamura 2014 Grade 5 Girls	505	48	11	474	31.5	14	31.00	16.74	-1.82	63.82	
Tamura 2014 Grade 6 Boys	506	28.9	17	482	74	13	24.00	21.69	-18.51	66.51	
Tamura 2014 Grade 6 Girls	491	47.9	8	492	29.9	12	-1.00	19.01	-38.25	36.25	
Tamura 2016 ⁸³	477.25	57.69	122	444.42	65.52	121	32.83	7.92	17.30	48.36	1
Taylor 2015 ⁸⁴	564	30.8847	89	564	30.8847	92	0.00	4.59	-9.00	9.00	2
Tomayko 2019 ⁸⁵	606	52.2	188	608.4	58.2	188	-2.40	5.70	-13.61	8.81	1

Study name (citation)	Published sleep duration at follow-up (minutes)						Effect estimates (minutes)				
	Intervention group			Control group			Intervention Effect	Standard Error	Confidence interval		Estimation method
	Mean	SD	Total	Mean	SD	Total			Lower	Upper	
Uhlig 2019 ⁸⁶	479.47	35.84	52	468.11	35.98	23	11.36	9.00	-6.28	29.00	1
Van Dyk 2017 ⁴²	442.2	24.9415	27	369.9	24.9415	27	72.30	6.79	59.00	85.60	1
Van Rijn 2020 ⁸⁷	359.4	45.6	97	358.8	47.4	108	0.60	6.50	-12.14	13.34	1
Walton 2015 ⁸⁸	744	25.2	27	744	34.2	21	-3.18	9.95	-22.80	16.20	2
Wilson 2014 ⁸⁹	660	54	45	624	54	42	36.00	11.59	13.29	58.71	2
Wing 2015 ⁹⁰	437		1545	434		2168	3.00	1.53	0.00	6.00	2
Wolfson 2015 ⁹¹	13	58	73	-12	43	70	25.00	8.57	8.06	41.94	2
Yoong 2018 ⁹²	672	78	14	642	60	15	54.00	21.43	12.00	96.00	2

Footnotes

Estimation method code 1: intervention effect determined from differences at follow-up between intervention and control groups in RevMan using means, SDs and sample size for intervention and control groups

Estimation method code 2: intervention effect is obtained from published estimates reporting change in the intervention group adjusted for change in the control group that used ANCOVA/repeated measures ANOVA/mixed models/multilevel models

Subgroups within the same study (shaded rows) were combined first using fixed effects meta-analysis for pooling with other studies