学童・思春期の睡眠と健康

第10回日本小児科医会
乳幼児学校保健研修会
2020月9月27日

公益社団法人地域医療振興協会
　東京ベイ浦安市川医療センター
子どもの早起きをすすめる会発起人
　　　　　　　　神山　潤

本日の内容

- 2016-2018年に小学生956名、中学生1049名、高校生717名を対象に神山が行ったアンケート結果をまとめた以下の論文内容をご紹介します。

１．Factors associated with sleep duration among pupils.

２．Associations of adolescents' lifestyle habits with their daytime functioning in Japan.

３．Lifestyle habits associated with screen time among pupils in Japan.

４．Lifestyle habits associated with poor defecation habit among pupils in Japan.

５．Pupils with negative social jetlag in Japan are hypothesised to constitute a discrete population.

論文1.

Original Article

Factors associated with sleep duration among pupils

Jun Kohyama, (iD) Makoto Ono, Yuki Anzai, Ai Kishino, Keita Tamanuki, Kengo Moriyama, Yoko Saito, Runa Emoto, George Fuse and Yoshiho Hatai

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Abstract   *Background*: Sleep shortage has been pervasive among pupils.
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*Conclusions*: Excessive after-school activity might be considered in association with pupils' sleep reduction.

睡眠時間の減少と有意に関連した要素を探った。

Table 2 Mean values and standard deviations for sleep duration in the examined pupils

School type	N	SD on weekdays (hours): mean/standard deviation (M; F) gender difference (P/Cohen's d))	SD on weekends (hours): mean/standard deviation (M; F) gender difference (P/Cohen's d))	Average SD (hours): mean/standard deviation (M; F) gender difference (P/Cohen's d))
ES	956 (M, 441; F, 515)	8.57/0.78 (M, 8.60/0.79; F, 8.55/0.78) (>0.05/0.07)	9.35/1.06 (M, 9.09/1.05; F, 9.58/1.01) (<0.01, 0.48)	8.80/0.73 (M: 8.74/0/74; F: 8.84/0.71) (>0.05/0.14)
JHS	1,049 (M, 541; F, 508)	7.43/1.08 (M: 7.55/1.13; F: 7.30/1.01) (<0.01, 0.23)	8.63/1.35 (M: 8.56/1.44; F: 8.70/1.25) (>0.05/0.10)	7.77/1.00 (M: 7.84/1.05: F: 7.70/0.93) (>0.05/0.14)
HS	717 (M, 385; F, 332)	6.53/1.02 (M: 6.56/1.01; F: 6.50/1.04) (>0.05/0.06)	8.02/1.54 (M: 7.95/1.60; F: 8.11/1.46) (>0.05/0.11)	6.96/1.00 (M: 6.96/1.00; F: 6.96/1.00) (>0.05/0.005)

ES, elementary school; F, female; HS, high school; JHS, junior high school; M, male; SD, sleep duration.

	平日前	休前日	平均
小学5, 6年	8.57	9.35	8.80
中学生	7.43	8.63	7.77
高校生	6.53	8.02	6.96

白：小学生（5, 6年）

灰：中学生

黒：高校生

平均睡眠時間[（平日前x5 ＋ 休前日x2)/7]
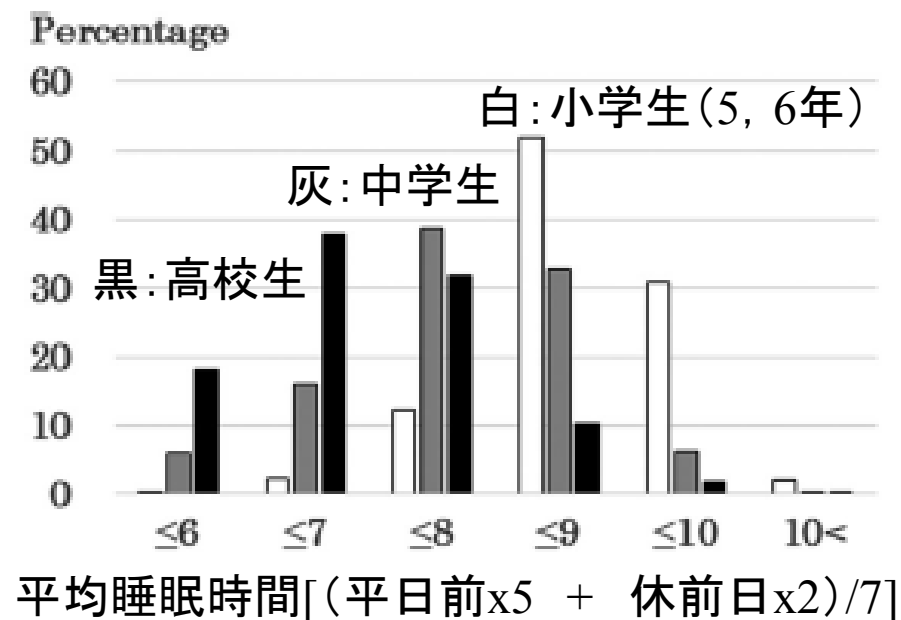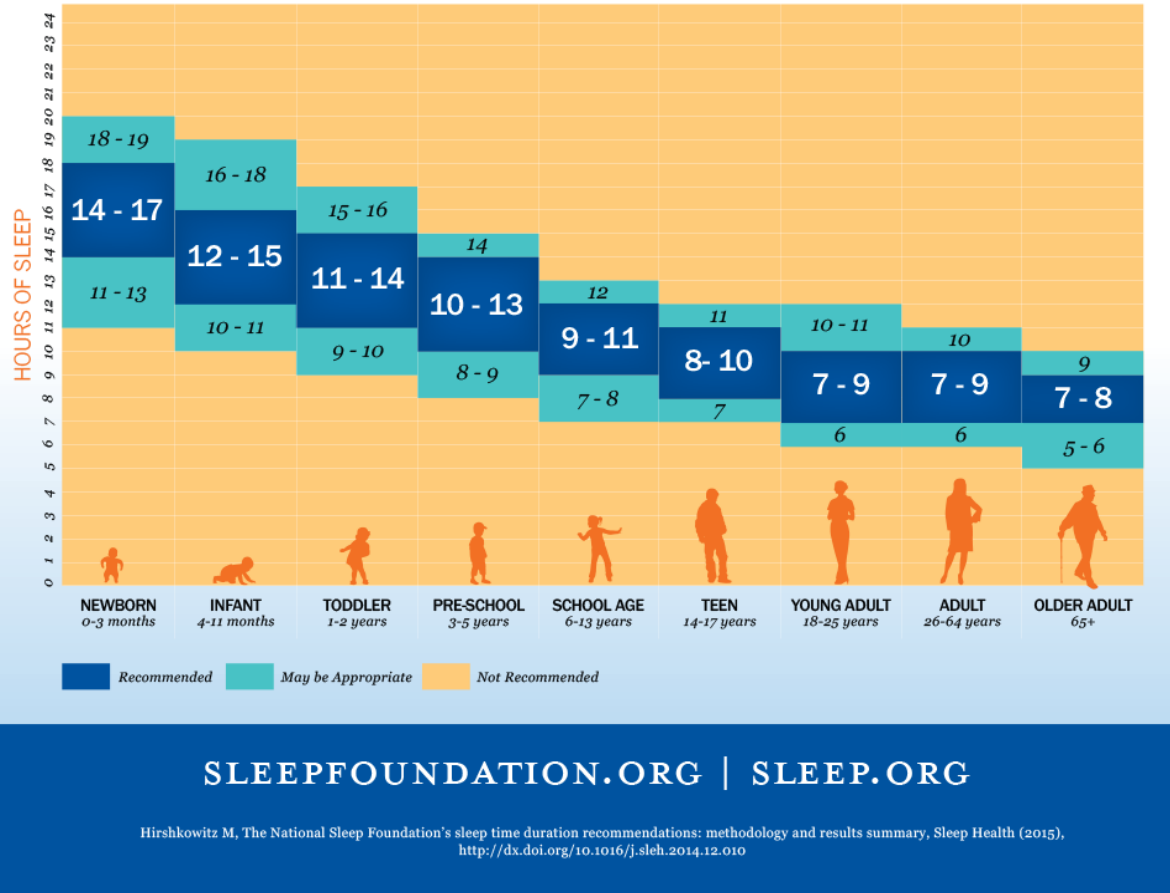
小児の推奨睡眠時間（含む昼寝）
乳児（4-12ヶ月）　12-16時間
1-2歳　　　　　　11-14時間
3-5歳　　　　　　10-13時間
6-12歳　　　　　　9-12時間
13-18歳　　　　　　8-10時間

Paruthi S, et al.: Recommended Amount of Sleep for Pediatric Populations: A Consensus Statement of the American Academy of Sleep Medicine. J Clin Sleep Med, 2016;12:785-786.

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赤字は推奨睡眠時間に達していない。

Original Article

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Conclusions: Excessive after-school activity might be considered in association with pupils' sleep reduction.

重回帰分析で睡眠時間の減少と有意に関連した要素は、

小（５、６年）中高ともに、課外活動の多さと眠気。
小（５、６年）では、朝食欠食、不規則な夕食時刻、非登校日のスクリーン時間の長さ、自己申告した成績優秀。
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高ではBMI高値。

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一口に認知機能といっても様々あり、断眠が影響を与えやすい機能、与えにくい機能がある（Lim J, Dinges DF. A meta-analysis of the impact of short term sleep deprivation on cognitive variables. Psychol. Bull. 2010; 136: 375–89.）。小学生のほうが中高性よりは多くの要素が睡眠時間に影響を与えていることから、小学生は今回検討していない他の多くの要素の影響もうけた結果、短睡眠時間と好成績の関連という結果が得られた可能性がある。

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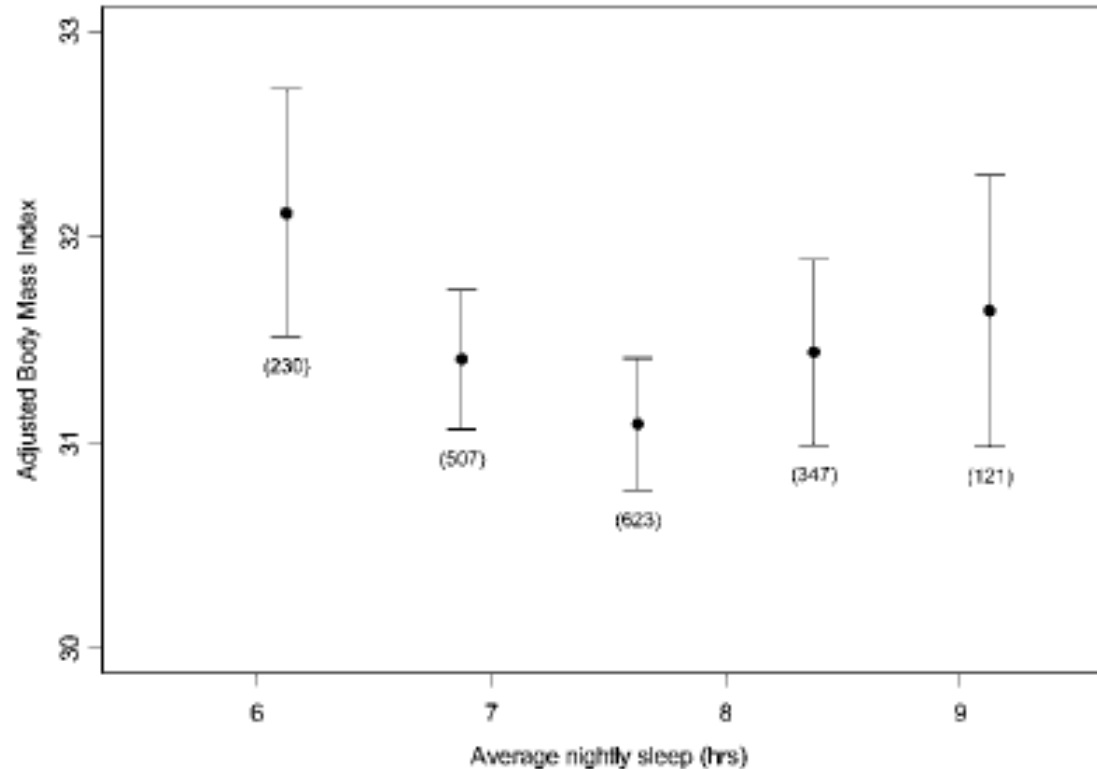小（５、６年）中では、登校日のスクリーン時間と学年上昇。
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寝ないと
太る

Taheri S, Lin L, Austin D, Young T, Mignot E.

Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index.
**PLoS Med. 2004 Dec;1(3):e62.**

Figure 2. The Relationship between BMI and Average Nightly Sleep

Mean BMI and standard errors for 45-min intervals of average nightly sleep after adjustment for age and sex. Average nightly sleep values predicting lowest mean BMI are represented by the central group. Average nightly sleep values outside the lowest and highest intervals are included in those categories. Number of visits is indicated below the standard error bars. Standard errors are adjusted for within-subject correlation.
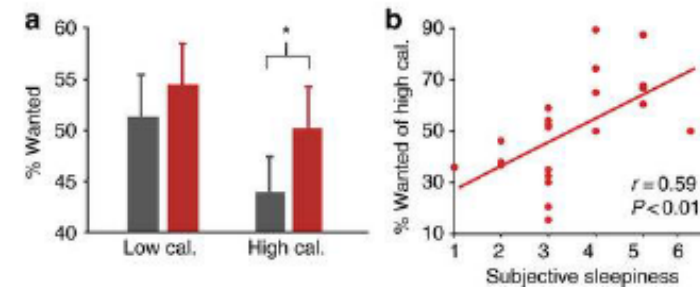
寝不足だと食欲が理性に勝る！？
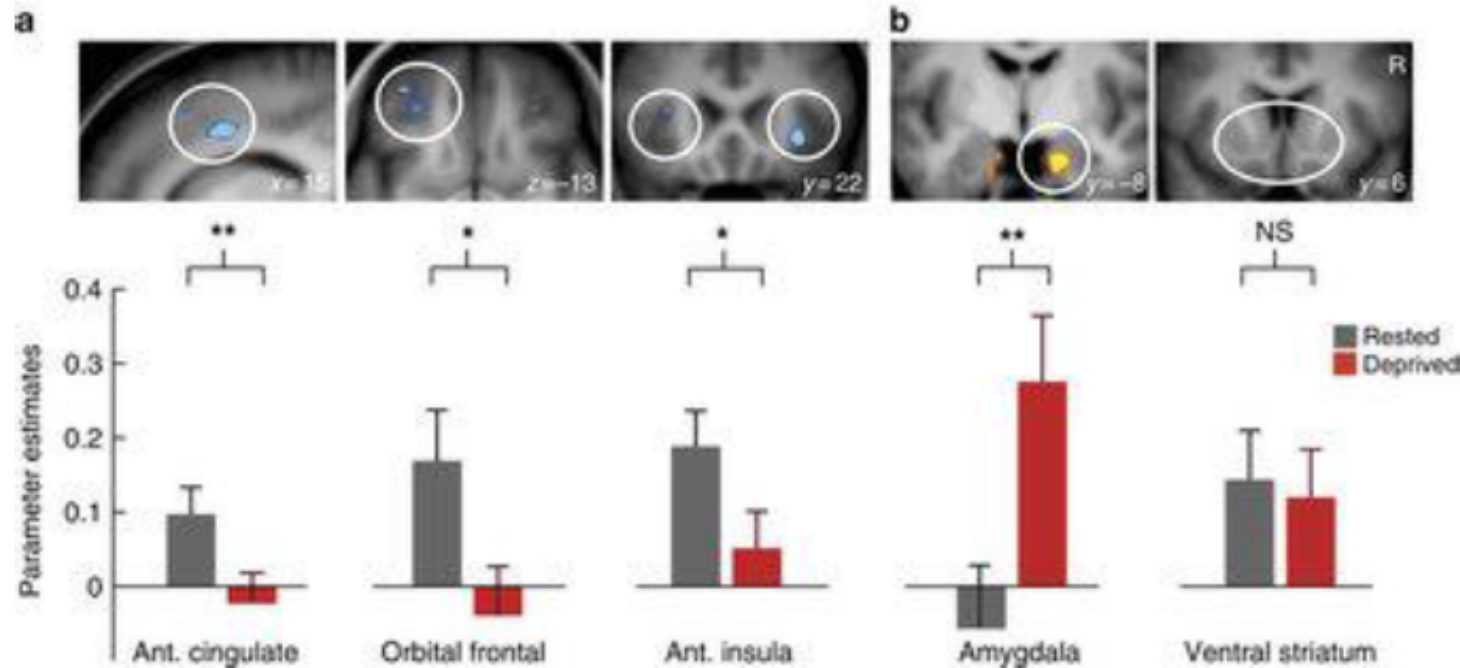
23人の健康な若者に睡眠を十分に取った翌日と徹夜した翌日MRIを撮影。

睡眠不足のときの脳では、判断力を司る前頭葉の活性が減少（a）。一方で、報酬や情動に関連する扁桃体の活性が増大。

さらに被験者に80種類の食事（果実や野菜などの健康的なものからジャンクフードまでの各種）をみせたところ、睡眠不足の時には高カロリー食を求め、また自覚的な睡眠不足の程度に応じて高カロリー食を好んだ。

前頭前野の
場所と働き

外側部
　行動の認知・実行制御
内側部
　心の理論・社会行動
腹側（眼窩）
　行動の情動・動機づけ

渡邊正孝 前頭連合野のしくみとはたらき
高次脳機能研究36(1):1-8, 2016)
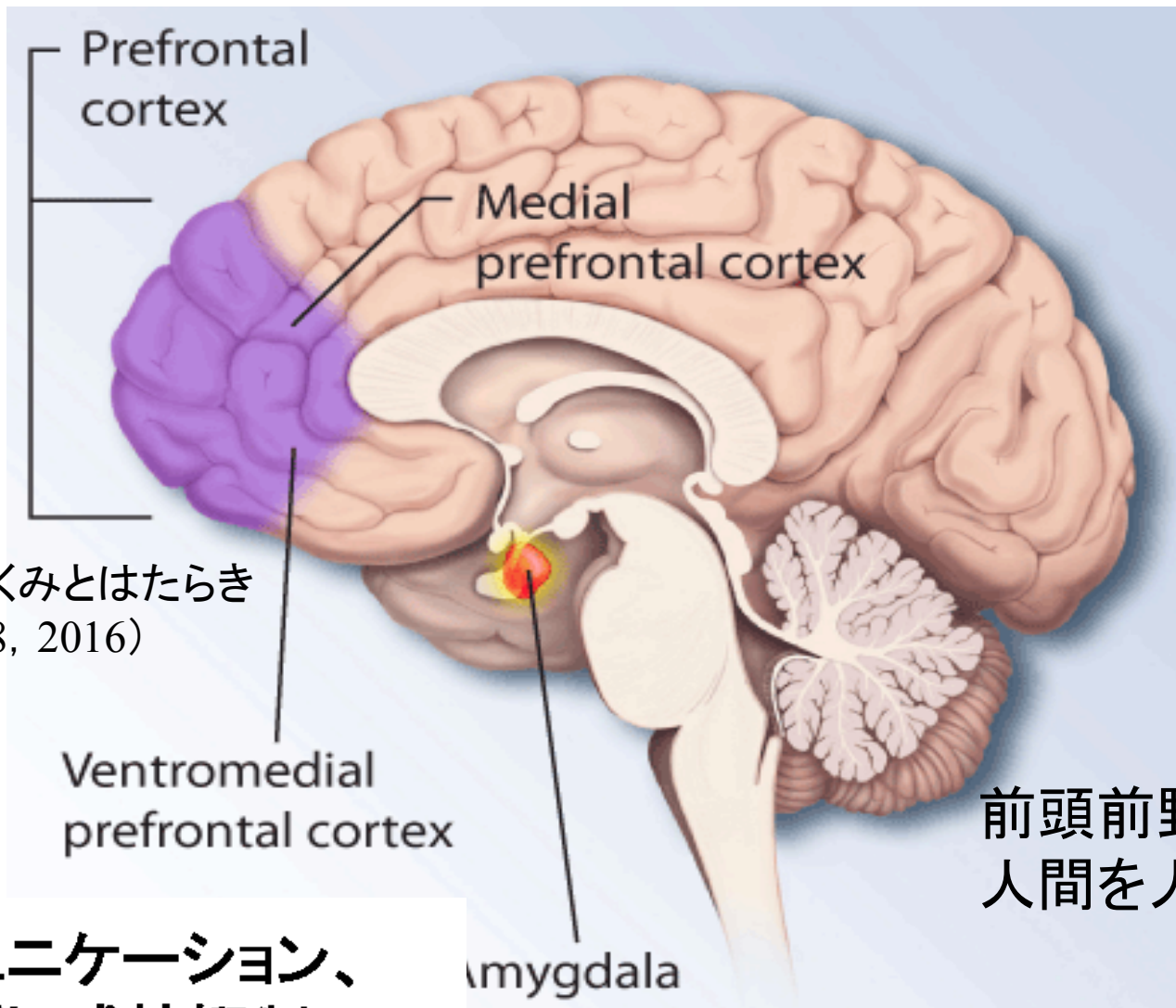
**意思決定、コミュニケーション、
思考、意欲、行動・感情抑制、
注意の集中・分散、
記憶コントロール。**

Prefrontal cortex

Medial prefrontal cortex

Ventromedial prefrontal cortex

Amygdala

1848年の
事故後も
ゲージは正常な記憶、言語、運動能力を保っていたが、彼の人格は大きく変化した。
彼は以前には見られなかったような怒りっぽく、気分屋で、短気な性格になり、彼の友人はすっかり変わってしまった彼を"もはやゲージではない。"と述べた。

前頭前野：
人間を人間たらしめている

ネコ　イヌ　アカゲザル　ヒト

親子の読み聞かせは
「心の脳」に働きかける

泰羅雅登

東京医科歯科大学大学院
医歯学総合研究科
認知神経生物学分野 元教授
（享年63歳、2017（平成29）年7月8日永眠。

子供の脳活動

Brain activity of the child.

辺縁系に活動
感情・情動
に関わる脳
心の脳に活動

お母さんの読み聞かせを
聞いているときの反応

お母さんはどう？

前頭前野が活発に
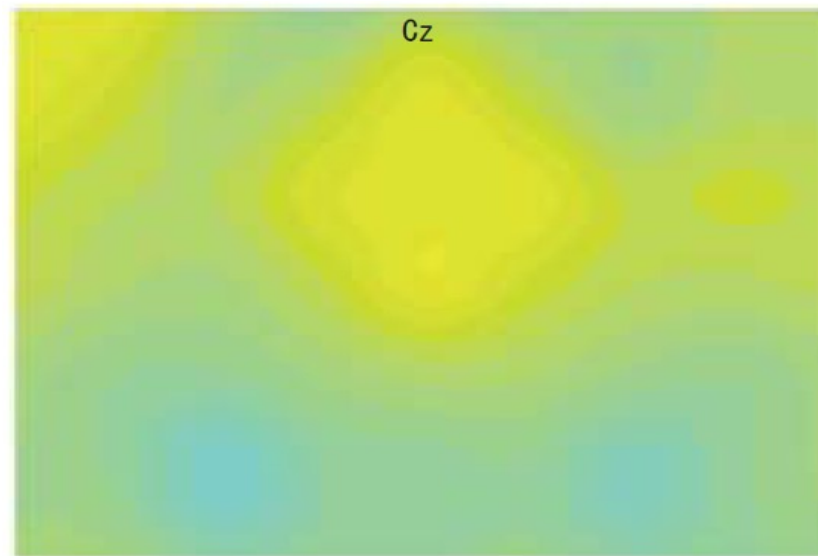
音読
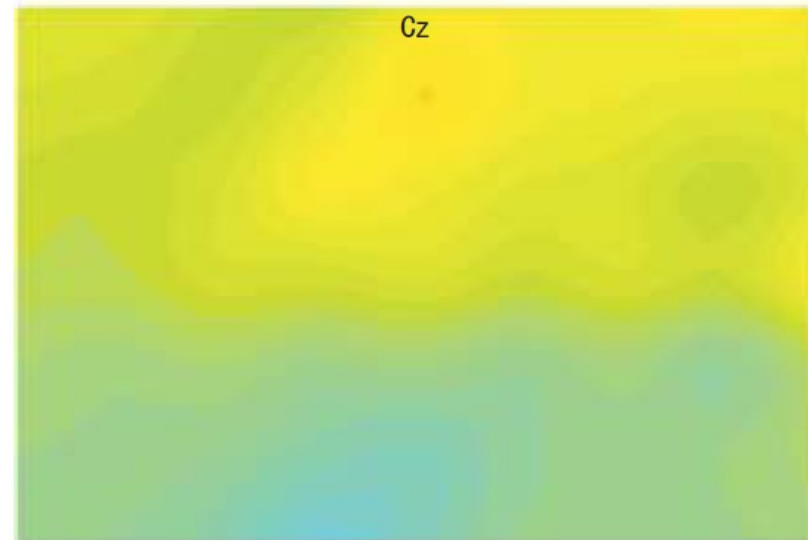
読み聞かせ

読み聞かせは
　　・お子さんの心に届く。
　　・入眠儀式として有用。
　　・また読み手（必ずしも養育者
　　　ばかりではないはず）の前頭前野
　　　の働きを高めるうえでも大切。

世界各国の睡眠時間　2018OECD発表
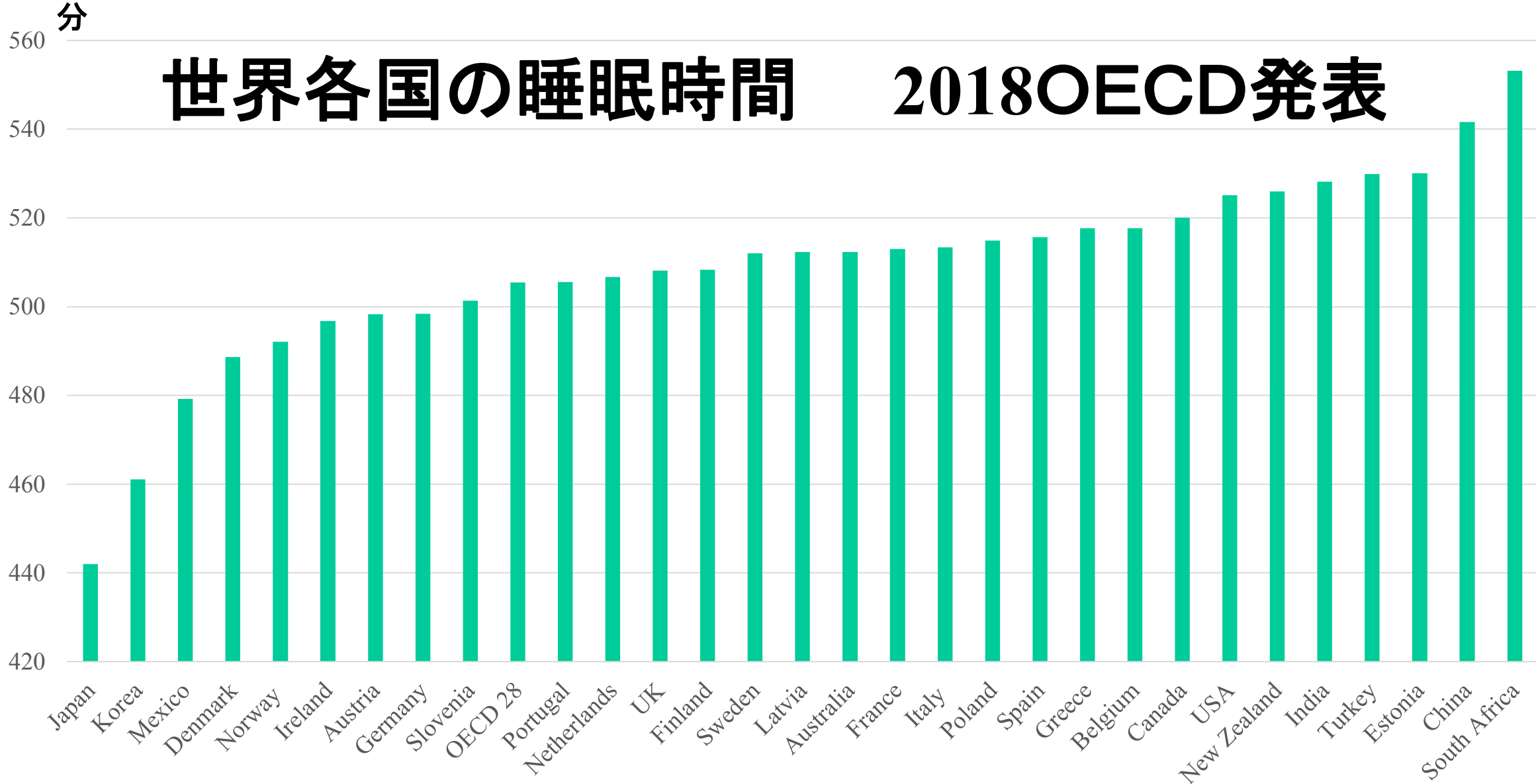
日本442分（男性448分、女性435分）、韓国461分、
・・・OECD平均505分（男性502分、女性510分）
・・・米国525分、中国542分、南アフリカ553分

OECD: Society at a Glance 2014
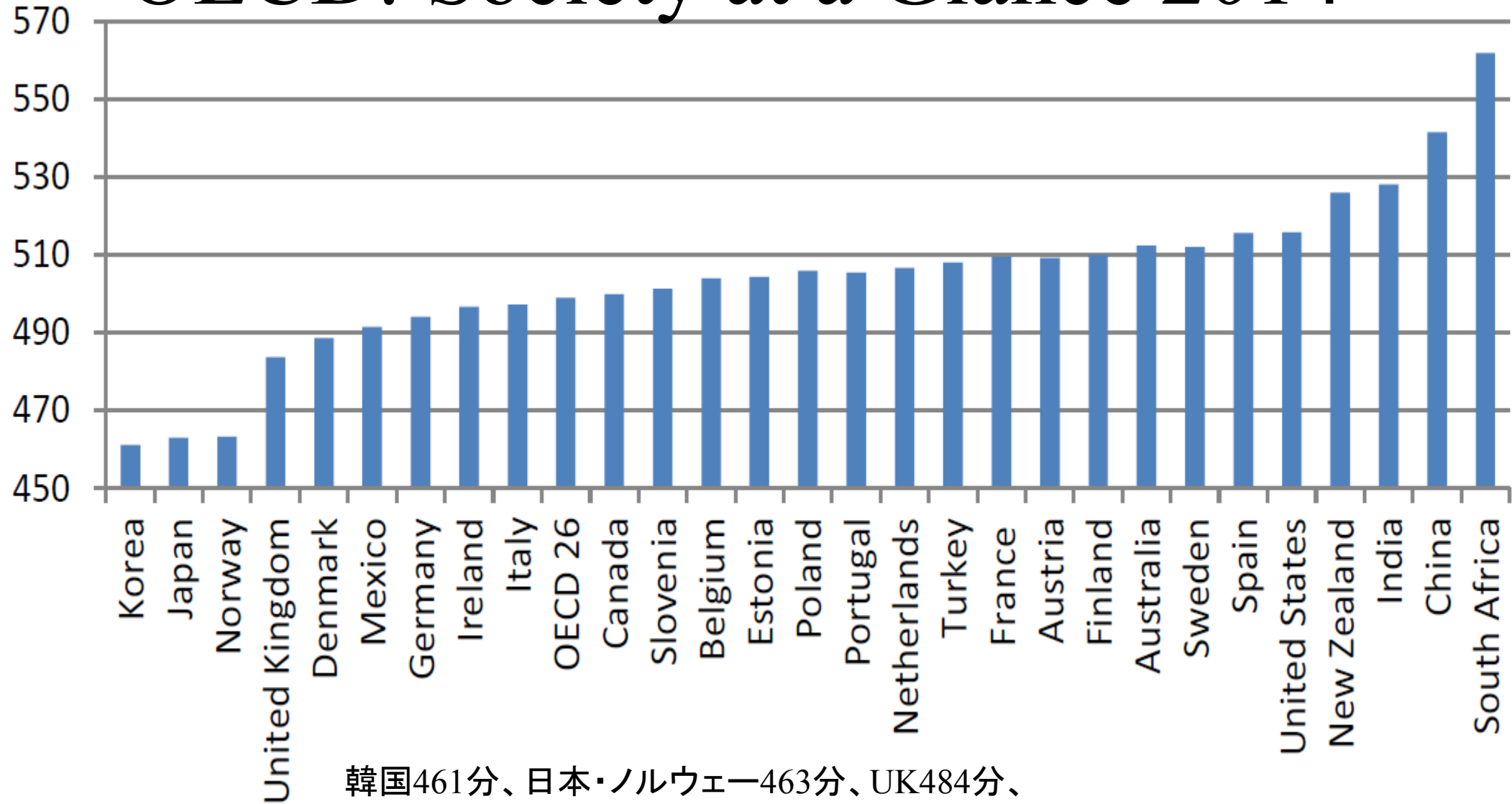
韓国461分、日本・ノルウェー463分、UK484分、
・・・OECD26　499分
・・・ニュージーランド526分、中国542分、南ア562分

世界各国の睡眠時間　2018OECD発表
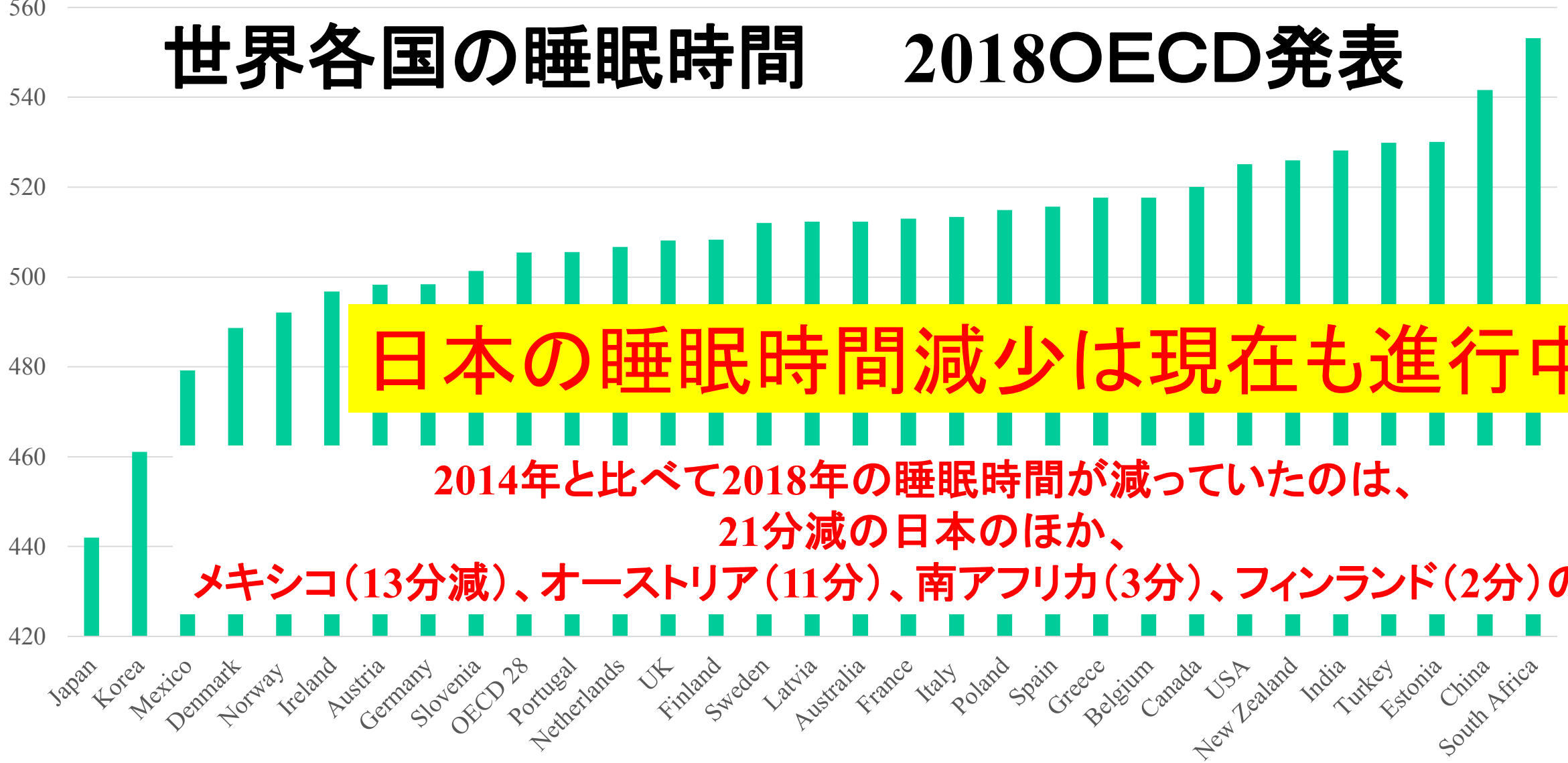
日本の睡眠時間減少は現在も進行中

2014年と比べて2018年の睡眠時間が減っていたのは、
21分減の日本のほか、
メキシコ（13分減）、オーストリア（11分）、南アフリカ（3分）、フィンランド（2分）のみ。

分

560
540
520
500
480
460
440
420

Japan / Korea / Mexico / Denmark / Norway / Ireland / Austria / Germany / Slovenia / OECD 28 / Portugal / Netherlands / UK / Finland / Sweden / Latvia / Australia / France / Italy / Poland / Spain / Greece / Belgium / Canada / USA / New Zealand / India / Turkey / Estonia / China / South Africa

日本442分（←463分）、韓国461分（←461分）、・・・ノルウェー（492分←461分）・・・
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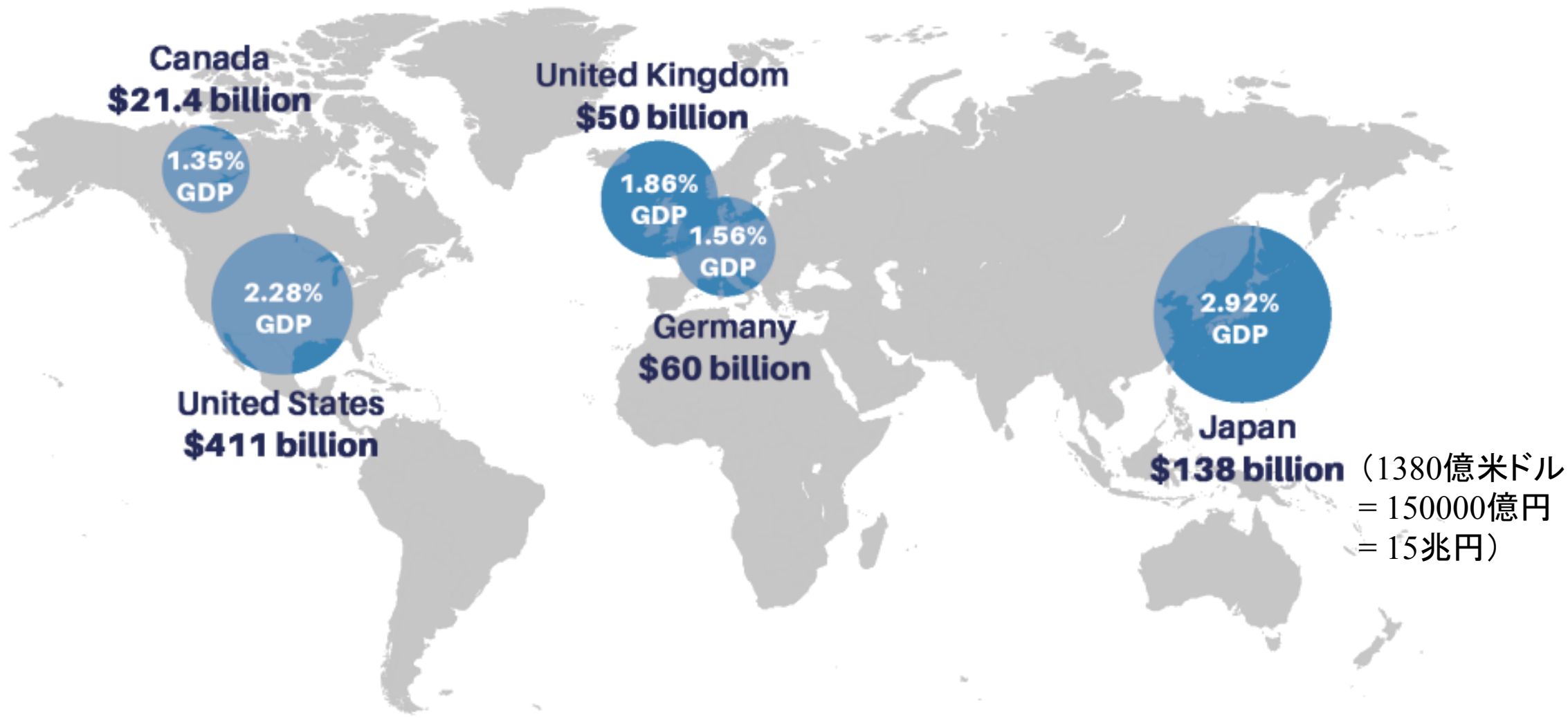
Map showing economic costs of insufficient sleep across five OECD countries
Jess Plumridge／RAND Europe

睡眠不足に伴う経済的損失を示す図

借眠の返済期間

- 普段連日平均7.5時間寝ていた方8名。

- 連日14時間ベッドで横になることを強制。

- 初日何時間寝たと思いますか？

- Barbato G[1], Barker C, Bender C, Giesen HA, Wehr TA. Extended sleep in humans in 14 hour nights (LD 10:14): relationship between REM density and spontaneous awakening. Electroencephalogr Clin Neurophysiol. 1994 Apr;90(4):291-7.

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- 連日14時間ベッドで横になることを強制。

- 初日、何時間寝たと思いますか？

- 1週間後、何時間寝たと思いますか？

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西野精治著
スタンフォード式最高の睡眠
サンマーク出版　p49

図4　「14時間連続」ベッドに入るとどうなる?

睡眠時間

実験直後は
13時間近く眠れるが…

この差「40分」が慢性的に
抱えていた睡眠負債

3週間後、平均8.2時間に固定される
＝生理的に必要とされている睡眠時間

実験前の平均睡眠時間は
7.5時間

経過
日数

⚠ 寝たいだけ寝ても、睡眠不足解消に3週間かかる!

- 実験初日　13時間眠った。
- その後睡眠時間は減り、1週間後には睡眠時間は9-10時間に。
- 実験開始3週間で睡眠時間は8.2時間で固定。　これが必要な睡眠時間であろう。
- つまりこの方々は期間は不明だが8.2-7.5＝0.7時間（42分）の睡眠不足が連日あった。
- そしてこの睡眠不足を解消するのに3週間かかった、といえる。

- Barbato G[1], Barker C, Bender C, Giesen HA, Wehr TA. Extended sleep in humans in 14 hour nights (LD 10:14): relationship between REM density and spontaneous awakening. Electroencephalogr Clin Neurophysiol. 1994 Apr;90(4):291-7.
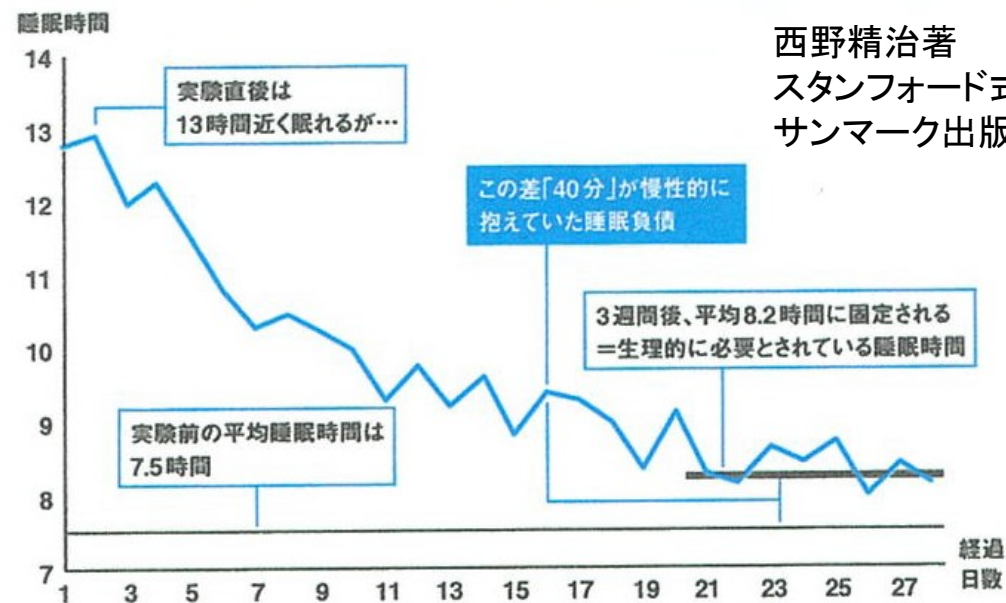
睡眠の心身への影響
　　睡眠の研究方法の問題点　　４時間睡眠で６晩（8, 12時間睡眠と比較）
　　　→　耐糖能低下（糖尿病）、夕方のコルチゾール低下不良（→肥満）、
　　　　　交感神経系活性上昇（高血圧）、ワクチンの抗体産生低下（免疫能低下）
　　　　　　　　　→　老化と同じ現象

Impact of sleep debt on metabolic and endocrine function

Summary

Background Chronic sleep debt is becoming increasingly common and affects millions of people in more-developed countries. Sleep debt is currently believed to have no adverse effect on health. We investigated the effect of sleep debt on metabolic and endocrine functions.

Methods We assessed carbohydrate metabolism, thyrotropic function, activity of the hypothalamo-pituitary-adrenal axis, and sympathovagal balance in 11 young men after time in bed had been restricted to 4 h per night for 6 nights. We compared the sleep-debt condition with measurements taken at the end of a sleep-recovery period when participants were allowed 12 h in bed per night for 6 nights.

Findings Glucose tolerance was lower in the sleep-debt condition than in the fully rested condition (p<0·02), as were thyrotropin concentrations (p<0·01). Evening cortisol concentrations were raised (p=0·0001) and activity of the sympathetic nervous system was increased in the sleep-debt condition (p<0·02).

Interpretation Sleep debt has a harmful impact on carbohydrate metabolism and endocrine function. The effects are similar to those seen in normal ageing and, therefore, sleep debt may increase the severity of age-related chronic disorders.

寝不足とメタボリックシンドロームの関係
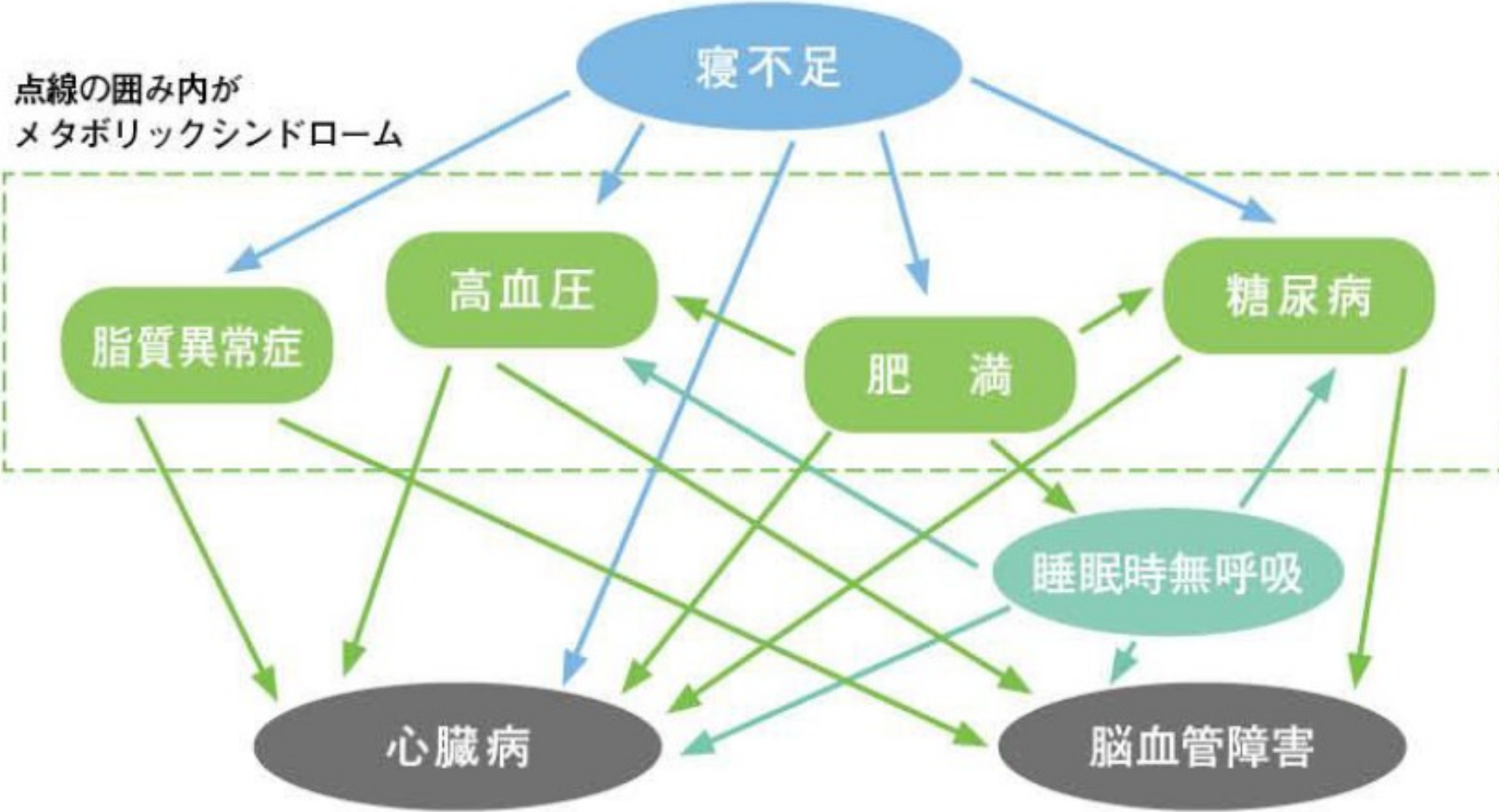
Fatigue, alcohol and performance impairment

Dawson A, & Reid K.　　p.235

・17時間の連続覚醒時のperformanceは酒酔い運転で逮捕されるレベル（0.05％）と同様！？
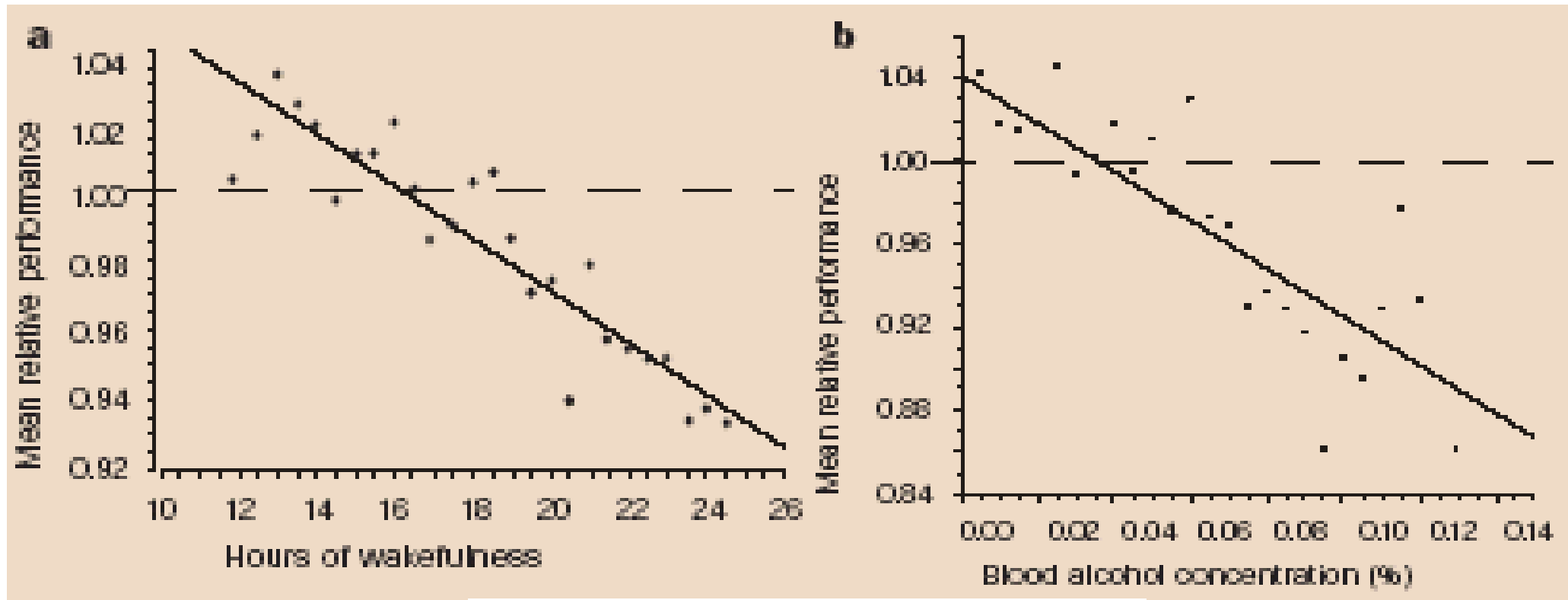
Figure 1 Scatter plot and linear regression of mean relative performance levels against: **a**, time, between the tenth and twenty-sixth hour of sustained wakefulness ($F_{1,24}=132.9$, $P<0.05$, $R^2=0.92$); and **b**, blood alcohol concentrations up to 0.13%, ($F_{1,24}=54.4$, $P<0.05$, $R^2=0.69$).

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乗るなら飲むな！
ですが、

Fatigue, alcohol and performance impairment

Dawson A, & Reid K. p.235

乗るなら飲むな！
ですが、
乗るなら眠れ！
（労働安全衛生総合研究所部長　高橋正也博士）
も大事。
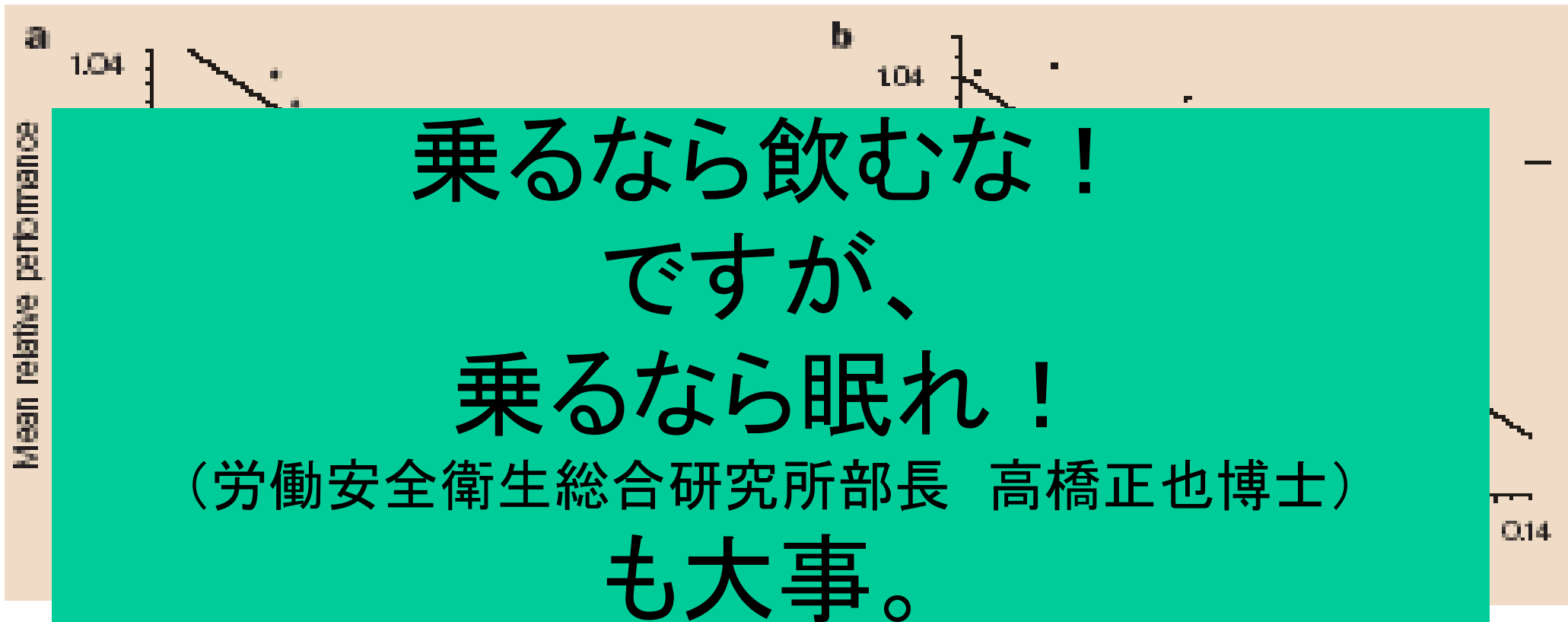
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2時間の睡眠不足、自動車事故のリスク倍増　米研究

１～２時間の「睡眠不足」で事故リスクが倍に

睡眠不足の状態で運転すると交通事故の危険性が高まることはよく知られているが、推奨される睡眠時間を１～２時間下回っただけで事故のリスクがほぼ倍増することが７日までに分かった。

　米高速道路交通安全局（ＮＨＴＳＡ）が２００５～０７年、午前６時から深夜０時までの時間帯に発生した交通事故４５７１件の原因について、ドライバー７２３４人を対象に実施した調査のデータを、全米自動車協会（ＡＡＡ）交通安全財団が改めて分析した。事故前の２４時間にドライバーがどれだけ睡眠を取っていたかによって分類したところ、適切な睡眠時間とされている７時間超に比べて、４時間未満しか眠っていないと事故発生率は１１．５倍、４～５時間だと４．３倍に跳ね上がった。さらに５～６時間眠っていても事故は１．９倍、６～７時間で１．３倍に増えることが分かった。

論文２．

Sleep Science

Associations of adolescents' lifestyle habits with their daytime functioning in Japan

Jun Kohyama [1]

[1] Tokyo Bay Urayasu Ichikawa Medical Centre, Sleep medicine - Urayasu - Chiba - Japan

ABSTRACT

Objective: To assess associations of adolescents' lifestyle habits with their daytime functioning in Japan. **Methods:** A total of 2,722 questionnaires obtained from pupils in grades 5 to 12 in Japan were assessed by the multiple comparison test to determine significant differences in the lifestyle habits among the self-reported academic performance categories (AP1: very good; AP2: good; AP3: not good; AP4: poor). **Results:** The average non-school-day screen time of AP4 pupils was significantly longer than that of AP1 pupils in elementary and junior high schools. In junior and senior high schools, AP4 pupils showed more sleepiness and higher occurrence of breakfast skipping than AP2 pupils. In all school types, sleep duration showed no significant differences among the self-reported academic performance categories. **Discussion:** Avoiding sleepiness, breakfast skipping, and heavy media usage is expected to ensure adolescents' daytime functioning. Although not studied here, napping might improve adolescents' daytime functioning.

Keywords: Screen Time; Academic Performance; Sleepiness; Breakfast.

自己申告した成績と有意に関連する要素を探った。

Sleep Schedules and Daytime Functioning in Adolescents

Amy R. Wolfson and Mary A. Carskadon

Sleep and waking behaviors change significantly during the adolescent years. The objective of this study was to describe the relation between adolescents' sleep/wake habits, characteristics of students (age, sex, school), and daytime functioning (mood, school performance, and behavior). A Sleep Habits Survey was administered in homeroom classes to 3,120 high school students at 4 public high schools from 3 Rhode Island school districts. Self-reported total sleep times (school and weekend nights) decreased by 40–50 min across ages 13–19, $ps < .001$. The sleep loss was due to increasingly later bedtimes, whereas rise times were more consistent across ages. Students who described themselves as struggling or failing school (C's, D's/F's) reported that on school nights they obtain about 25 min less sleep and go to bed an average of 40 min later than A and B students, $ps < .001$. In addition, students with worse grades reported greater weekend delays of sleep schedule than did those with better grades. Furthermore, this study examined a priori defined *adequate* sleep habit groups versus *less than adequate* sleep habit groups on their daytime functioning. Students in the short school-night total sleep group (<6 hr 45 min) and/or large weekend bedtime delay group (>120 min) reported increased daytime sleepiness, depressive mood, and sleep/wake behavior problems, $ps < .05$, versus those sleeping longer than 8 hr 15 min with less than 60 min weekend delay. Altogether, most of the adolescents' surveyed do not get enough sleep, and their sleep loss interferes with daytime functioning.

成績不良と申告した生徒は、登校日には成績良好と申告した生徒よりも25分睡眠時間が短く、就床が40分遅かった。

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Table 2 Means and Standard Deviations for School-Night and Weekend Sleep Variables by Grades

Sleep/Wake Variables	Self-Reported Grades				F Value	Bonferroni
	Mostly A's or A's/B's (n = 1,238)	Mostly B's or B's/C's (n = 1,371)	Mostly C's or C's/D's (n = 390)	Mostly D's/F's (n = 61)		
School-night TST	442 (62)	441 (66)	424 (74)	408 (94)	16.66***	A, B > C, D/F
School-night bedtime	10:27 P.M. (53)	10:32 P.M. (56)	10:52 P.M. (65)	11:22 P.M. (81)	24.58***	A, B < C, D/F
School-night rise time	6:02 A.M. (25)	6:05 A.M. (29)	6:10 A.M. (34)	6:09 A.M. (31)	ns	· · ·
Weekend TST	547 (100)	547 (109)	534 (124)	549 (137)	ns	· · ·
Weekend bedtime	12:06 A.M. (78)	12:29 A.M. (82)	1:09 A.M. (97)	1:33 A.M. (93)	51.32***	A < B < C, D/F
Weekend rise time	9:21 A.M. (97)	9:43 A.M. (103)	9:59 A.M. (113)	10:33 A.M. (160)	24.10***	A < B < C, D/F
Weekend oversleep	105 (101)	108 (114)	109 (130)	137 (159)	3.32*+	A, B, C < D/F
Weekend delay	99 (68)	117 (72)	137 (77)	133 (80)	26.53***	A < B < C, D/F

Note: TST refers to total sleep time (minutes). Weekend oversleep is the difference between weekend and school-night total sleep times, and weekend delay is the difference between weekend and school-night bedtimes. Standard deviations, in parentheses, are in minutes; TST, weekend oversleep, and weekend delay are in minutes as well.

* $p < .05$; ** $p < .01$; *** $p < .001$; + does not meet effect size criterion (e.g., effects where two groups differ by more than one-third of the sample standard deviation).
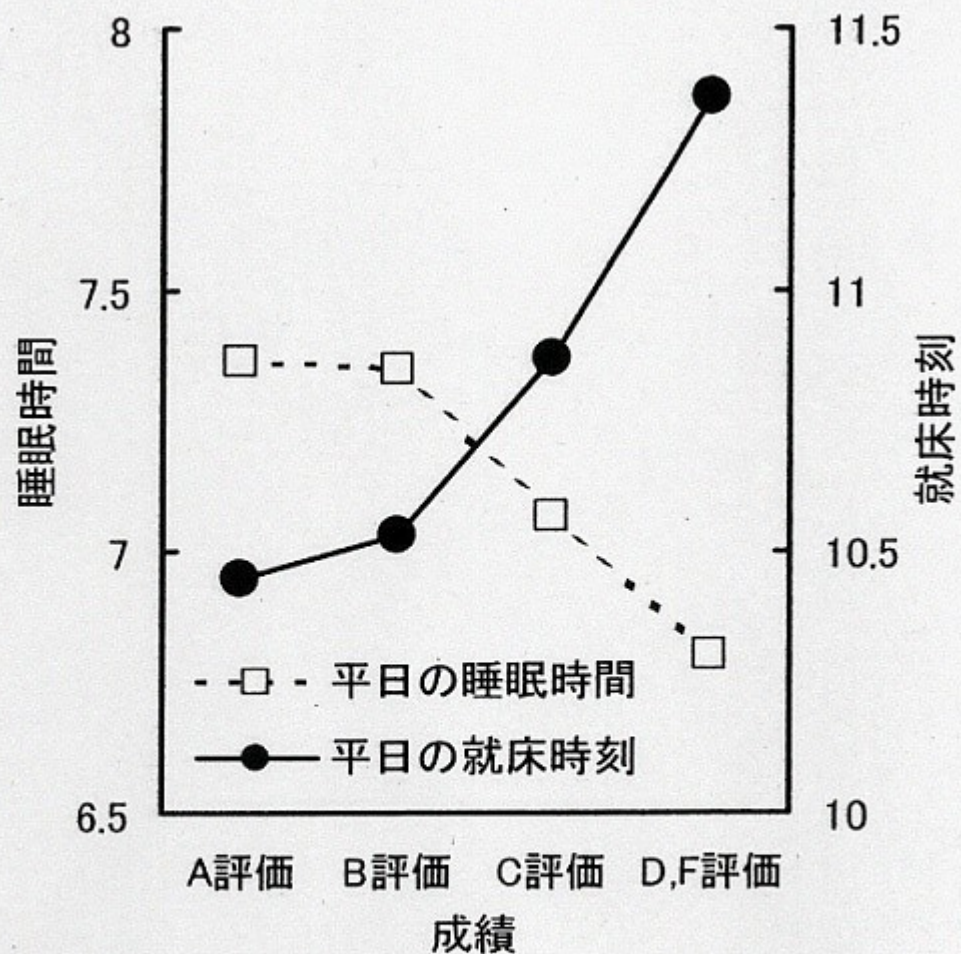
図7　睡眠習慣と成績の関係（アメリカの高校生のデータ；Wolfson & Carskadon, 1998に基づいて作図）[11]

一括して扱ったところ、1998年の報告同様、AP4（成績不良）の就床時刻は他の3群より遅く、登校前日の睡眠時間はAP1（成績良好）, AP2（成績まあ良い）よりも短く、非登校日の起床時刻はA1より遅かった。

13－19歳を一括して扱うのは
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　眠気
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高校生では
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小中高別に検討したところ、
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Table 3. Means and standard deviations of lifestyle variables in each self-reported academic performance category with a pair showing significant difference among four self-reported academic performance categories in each school type.

School types and lifestyle variables	Self-reported academic performance categories [AP1: very good; AP2: good; AP3: not good; AP4: poor] (number of pupils)				A pair showing a significant difference (Cohen's d value)
ES	AP1 (153)	AP2 (525)	AP3 (246)	AP4 (32)	
Non-school-day screen time: mean (hr)±SD (hr)	2:59±2.03	3:16±1.91	3:44±2.02	4:00±2.38	AP1-AP3** (0.38)
					AP1-AP4* (0.46)
JHS	AP1 (79)	AP2 (403)	AP3 (422)	AP4 (145)	
School night bedtime: mean (time)±SD (hr)	22:58±1.21	22:54±1.02	23:02±1.06	23:28±1.41	AP1-AP4** (0.38)
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Non-school-day wake time: mean (time)±SD (hr)	7:40±1.33	8:00±1.38	8:02±.50	8:23±.82	AP1-AP4** (0.45)
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					AP2-AP4** (0.53)
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School-day screen time: mean (hr)±SD (hr)	1:47±1.55	2:00±1.36	2:12±1.55	3:01±2.25	AP1-AP4** (0.64)
					AP2-AP4** (0.56)
					AP3-AP4** (0.43)
Non-school-day screen time: mean (hr)±SD (hr)	3:28±2.33	3:28±2.02	3:42±2.15	4:35±2.70	AP1-AP4** (0.45)
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Sleepiness score: mean±SD	1.97±0.82	1.88±0.69	2.04±0.70	2.25±0.87	AP2-AP4** (0.47)
Skipping breakfast score: mean±SD	1.09±0.40	1.11±0.38	1.25±0.56	1.57±0.93	AP1-AP4** (0.68)
					AP2-AP4** (0.66)
					AP3-AP4** (0.42)
HS	AP1 (56)	AP2 (274)	AP3 (287)	AP4 (100)	
Sleepiness score: mean±SD	2.34±0.88	2.36±0.77	2.56±0.81	2.92±0.97	AP1-AP4** (0.63)
					AP2-AP4** (0.64)
					AP3-AP4** (0.40)
Skipping breakfast score: mean±SD	1.32±0.74	1.24±0.60	1.36±0.72	1.59±0.98	AP2-AP4** (0.43)

Note: ES: elementary school; JHS: junior high school; HS: high school; * $p<0.05$; ** $p<0.01$.

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Original Article

Factors associated with sleep duration among pupils

Jun Kohyama, (iD) Makoto Ono, Yuki Anzai, Ai Kishino, Keita Tamanuki, Kengo Moriyama, Yoko Saito, Runa Emoto, George Fuse and Yoshiho Hatai

Department of Pediatrics, Tokyo Bay Urayasu Ichikawa Medical Center, Urayasu, Japan

Abstract
Background: Sleep shortage has been pervasive among pupils.
Methods: Multiple regression analysis was used to analyze 2,722 questionnaires obtained from grade 5 to 12 pupils, to determine factors associated with sleep duration.
Results: Significant regression formulae for sleep duration were obtained for all school types: adjusted R^2/ P value were 0.14/<0.001 for elementary school; 0.11/<0.001 for junior high school; 0.06/<0.001 for high school. Longer after-school activities (standardized regression coefficient/ P value were −0.22/<0.001 for elementary school; −0.10/<0.01 for junior high school; −0.18/<0.001 for high school) and more sleepiness (−0.09/<0.001 for elementary school; −0.07/<0.05 for junior high school; −0.07/<0.05 for high school) were significantly associated with reduced sleep duration for all school types. In both elementary and junior high schools, the higher grade (−0.53/<0.001 for elementary school; −0.10/<0.01 for junior high school), and longer weekday screen time (−0.15/<0.001 for elementary school; −0.19/<0.001 for junior high school) were also significantly associated with sleep loss. In elementary school, irregular dinner (−0.07/<0.05), breakfast skipping (−0.11/<0.001), longer weekend screen time (−0.09/<0.05) and better self-reported academic performance (0.07/<0.05) also revealed significant associations with sleep loss. In high school, reduction of sleep duration was also significantly associated with higher standardized body mass index (−0.08/<0.05).
Conclusions: Excessive after-school activity might be considered in association with pupils' sleep reduction.

重回帰分析で睡眠時間の減少と有意に関連した要素は、

小（５、６年）中高ともに、課外活動の多さと眠気。
小（５、６年）では、朝食欠食、不規則な夕食時刻、非登校日のスクリーン時間の長さ、自己申告した成績優秀。
小（５、６年）中では、登校日のスクリーン時間と学年上昇。
高ではBMI高値。

Self-Regulation and Sleep Duration, Sleepiness, and Chronotype in Adolescents

Judith A. Owens, MD, MPH,[a] Tracy Dearth-Wesley, PhD, MPH,[b] Daniel Lewin, PhD,[c] Gerard Gioia, PhD,[d] Robert C. Whitaker, MD, MPH[b,e,f]

思春期においては、日中の眠気が大なことと夜型であることが、それぞれ独立して自己制御（self-regulation）の低下に関連するが、睡眠時間短縮は関連していない。

OBJECTIVE: To determine whether shorter school-night sleep duration, greater daytime sleepiness, and greater eveningness chronotype were associated with lower self-regulation among adolescents.

METHODS: An online survey of 7th- to 12th-grade students in 19 schools in Fairfax County, Virginia Public Schools was conducted in 2015. Self-regulation was measured with the Behavior Rating Inventory of Executive Function, 2nd edition, Screening Self-Report Form. Sleep measures included school night-sleep duration (hours between usual bedtime and wake time), daytime sleepiness (Sleepiness Scale in the Sleep Habits Survey, tertiles), and chronotype (Morningness–Eveningness Scale for Children, continuous score and tertiles). Sociodemographic factors and mental health conditions were analyzed as potential confounders.

RESULTS: Among 2017 students surveyed, the mean age was 15.0 years (range, 12.1–18.9 years), and 21.7% slept <7 hours on school nights. In regression models adjusted for confounders, there was a significant independent association between self-regulation and both chronotype ($P < .001$) and daytime sleepiness ($P < .001$) but not sleep duration ($P = .80$). Compared with those in the lowest tertile of daytime sleepiness, those in the highest tertile had lower (0.59 SD units; 95% confidence interval, 0.48–0.71) self-regulation, as did those in the eveningness tertile of chronotype compared with those in the morningness tertile (0.35 SD units lower; 95% confidence interval, 0.24–0.46).

CONCLUSIONS: Among adolescents, greater daytime sleepiness and greater eveningness chronotype were independently associated with lower self-regulation, but shorter sleep duration was not. Aspects of sleep other than school-night sleep duration appear to be more strongly associated with self-regulation.

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					AP3-AP4** (0.43)
Non-school-day screen time: mean (hr)±SD (hr)	3:28±2.33	3:28±2.02	3:42±2.15	4:35±2.70	AP1-AP4** (0.45)
					AP2-AP4** (0.47)
					AP3-AP4** (0.36)
Sleepiness score: mean±SD	1.97±0.82	1.88±0.69	2.04±0.70	2.25±0.87	AP2-AP4** (0.47)
Skipping breakfast score: mean±SD	1.09±0.40	1.11±0.38	1.25±0.56	1.57±0.93	AP1-AP4** (0.68)
					AP2-AP4** (0.66)
					AP3-AP4** (0.42)
HS	AP1 (56)	AP2 (274)	AP3 (287)	AP4 (100)	
Sleepiness score: mean±SD	2.34±0.88	2.36±0.77	2.56±0.81	2.92±0.97	AP1-AP4** (0.63)
					AP2-AP4** (0.64)
					AP3-AP4** (0.40)
Skipping breakfast score: mean±SD	1.32±0.74	1.24±0.60	1.36±0.72	1.59±0.98	AP2-AP4** (0.43)

Note: ES: elementary school; JHS: junior high school; HS: high school; * $p<0.05$; ** $p<0.01$.

Original Article

Factors associated with sleep duration among pupils

Jun Kohyama, (iD) Makoto Ono, Yuki Anzai, Ai Kishino, Keita Tamanuki, Kengo Moriyama, Yoko Saito, Runa Emoto, George Fuse and Yoshiho Hatai

Department of Pediatrics, Tokyo Bay Urayasu Ichikawa Medical Center, Urayasu, Japan

Abstract *Background*: Sleep shortage has been pervasive among pupils.
Methods: Multiple regression analysis was used to analyze 2,722 questionnaires obtained from grade 5 to 12 pupils, to determine factors associated with sleep duration.
Results: Significant regression formulae for sleep duration were obtained for all school types: adjusted R^2/ P value were 0.14/<0.001 for elementary school; 0.11/<0.001 for junior high school; 0.06/<0.001 for high school. Longer after-school activities (standardized regression coefficient/ P value were −0.22/<0.001 for elementary school; −0.10/<0.01 for junior high school; −0.18/<0.001 for high school) and more sleepiness (−0.09/<0.001 for elementary school; −0.07/<0.05 for junior high school; −0.07/<0.05 for high school) were significantly associated with reduced sleep duration for all school types. In both elementary and junior high schools, the higher grade (−0.53/<0.001 for elementary school; −0.10/<0.01 for junior high school), and longer weekday screen time (−0.15/<0.001 for elementary school; −0.19/<0.001 for junior high school) were also significantly associated with sleep loss. In elementary school, irregular dinner (−0.07/<0.05), breakfast skipping (−0.11/<0.001), longer weekend screen time (−0.09/<0.05) and better self-reported academic performance (0.07/<0.05) also revealed significant associations with sleep loss. In high school, reduction of sleep duration was also significantly associated with higher standardized body mass index (−0.08/<0.05).
Conclusions: Excessive after-school activity might be considered in association with pupils' sleep reduction.

睡眠時間の減少と有意に関連した要素は、

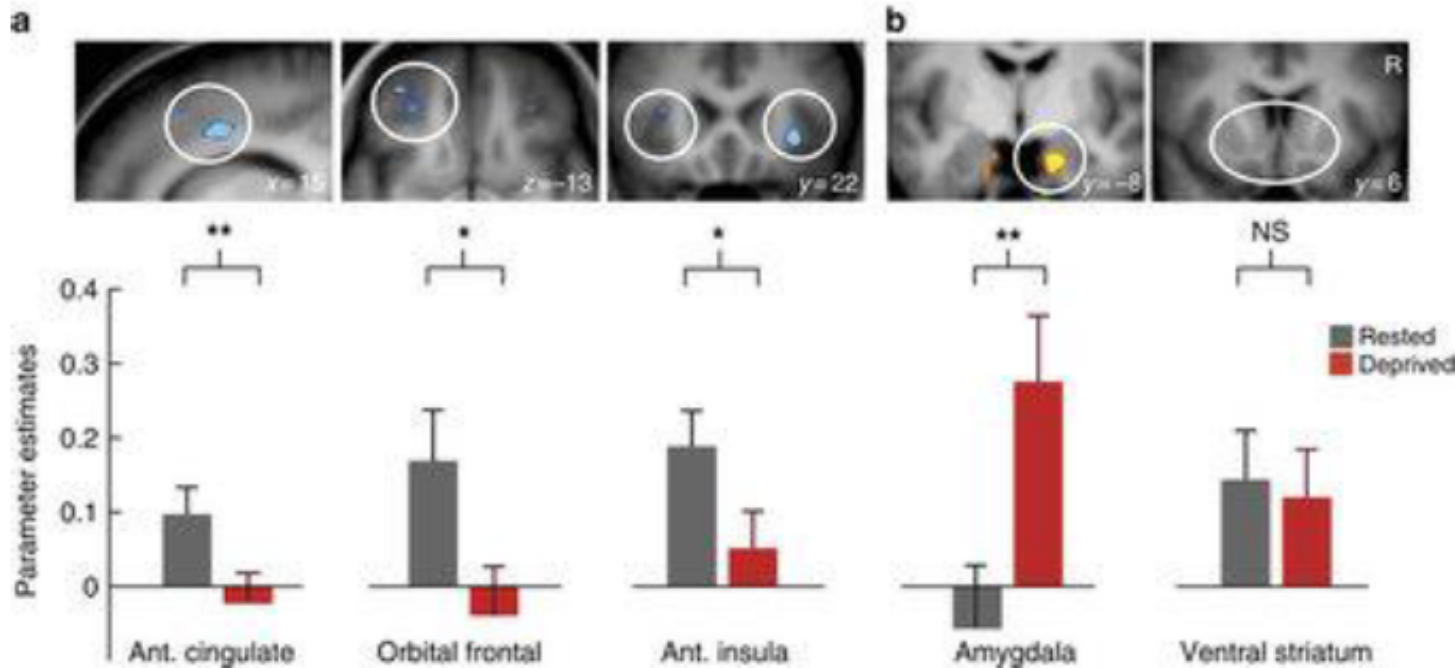小（５、６年）中高ともに、課外活動の多さと眠気。
小（５、６年）では、朝食欠食、不規則な夕食時刻、非登校日のスクリーン時間の長さ、成績優秀。
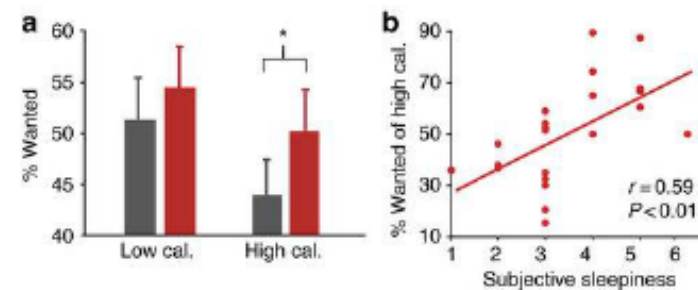小（５、６年）中では、登校日のスクリーン時間と学年上昇。
高ではBMI高値。

寝不足だと食欲が理性に勝る！？

23人の健康な若者に睡眠を十分に取った翌日と徹夜した翌日MRIを撮影。

睡眠不足のときの脳では、判断力を司る前頭葉の活性が減少（a）。一方で、報酬や情動に関連する扁桃体の活性が増大。

さらに被験者に80種類の食事（果実や野菜などの健康的なものからジャンクフードまでの各種）をみせたところ、睡眠不足の時には高カロリー食を求め、また自覚的な睡眠不足の程度に応じて高カロリー食を好んだ。

スマホ・メディア使用過多での睡眠不足では前頭前野活性の上昇は期待薄！？

論文3.

Original Article

Lifestyle habits associated with screen time among pupils in Japan

Jun Kohyama (iD)

Department of Paediatrics, Tokyo Bay Urayasu Ichikawa Medical Centre, Urayasu, Japan

Abstract   *Background*: Media use is pervasive among pupils. This study aimed to determine lifestyle factors associated with screen time.

Methods: The study used a cross-sectional design, and 2,722 questionnaires obtained from pupils in grades 5–12 were analyzed. Multiple regression analysis was used to determine significant lifestyle factors associated with screen time. Grade, gender, bedtime and waking time on both school days and non-school days, academic performance, sleepiness, breakfast, dinner regularity, defecation habits, hours of after-school activities, physical activity, and body mass index were used as the variables.

Results: Significant regression formulae were obtained for all school types: adjusted R^2/P values were 0.21/<0.001 for elementary school, 0.21/<0.001 for junior high school, and 0.14/<0.001 for high school. Later non-school-day bedtime (standardized regression coefficient/P values were 0.14/< 0.001 for elementary school, 0.14/<0.001 for junior high school, and 0.09/<0.05 for high school) was significantly associated with increased screen time for all school types. In both elementary and junior high schools, more sleepiness (0.12/<0.001 for elementary school, 0.13/<0.001 for junior high school), shorter after-school activity (−0.24/<0.001 for elementary school, −0.19/<0.001 for junior high school), and higher standardized body mass index (0.08/<0.05 for elementary school, 0.08/<0.01 for junior high school) were significantly associated with screen time increase. In both junior and senior high schools, breakfast skipping (0.15/<0.001 for junior school, 0.14/<0.001 for high school) revealed a significant association with screen time increase.

Conclusions: Media use is associated with variable lifestyle habits. Effective approaches to reduce heavy media use remain to be determined.

スクリーン時間と有意に関連した要素を重回帰分析で探った。

スクリーン時間の差異（学校種別及び登校日（左）と非登校日（右））

小学生956名、中学生1049名、高校生717名、2016-2018年神山調べ

登校日

非登校日

凡例: ■ 2時間まで　■ 2-4時間　■ 4-6時間　■ 6-8時間　■ 8時間以上

横軸: 小5/6　中学　高校　小5/6　中学　高校
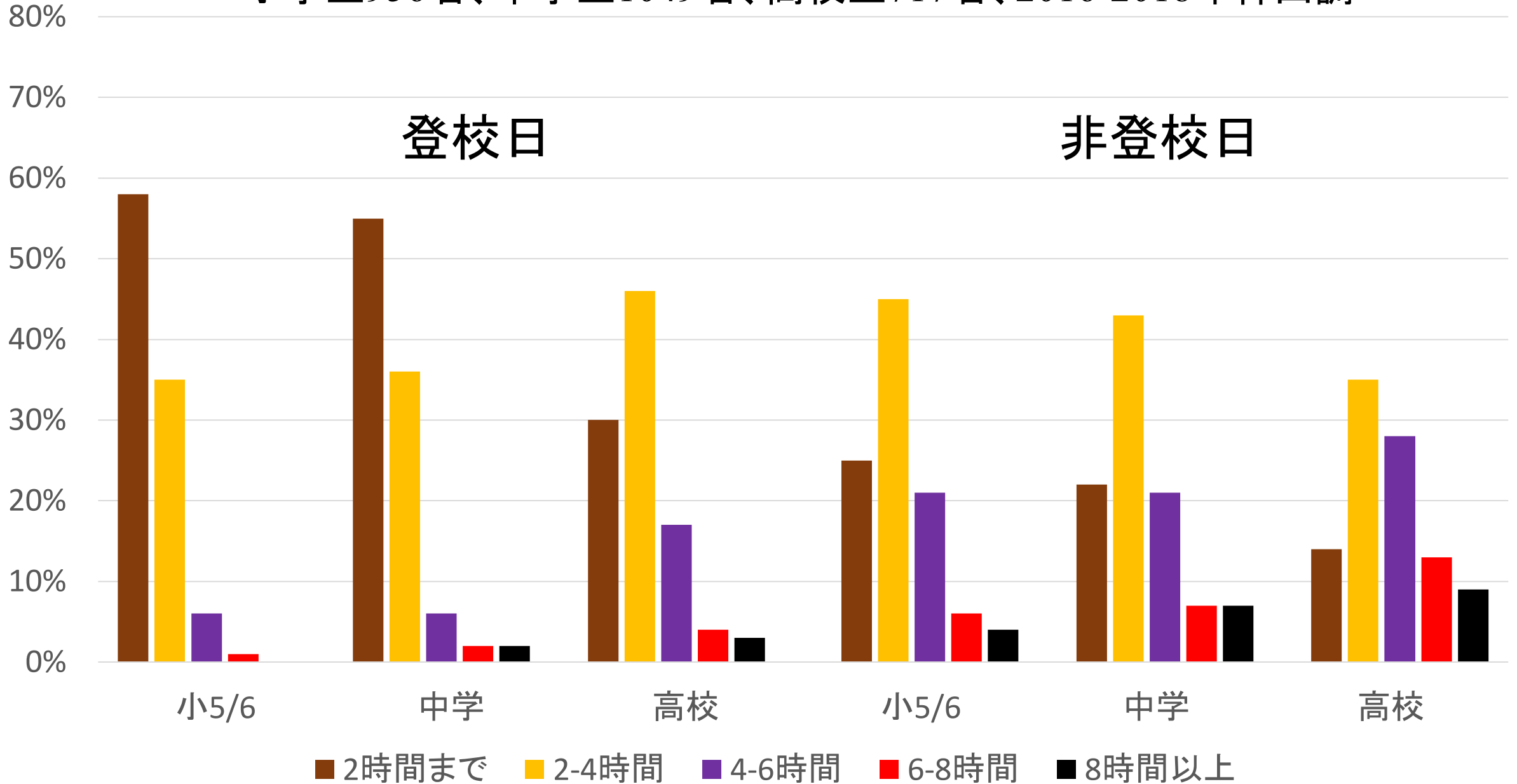
Lifestyle habits associated with screen time among pupils in Japan. Kohyama J. Ped Int in press　の結果。

スクリーン時間が増えることと有意に関連した要素は

小学5年から高校3年まで。
- 休前日の就床時刻が遅くなった。

小学5年から中学生まで。
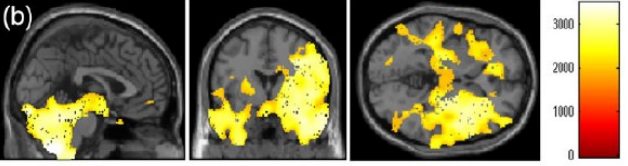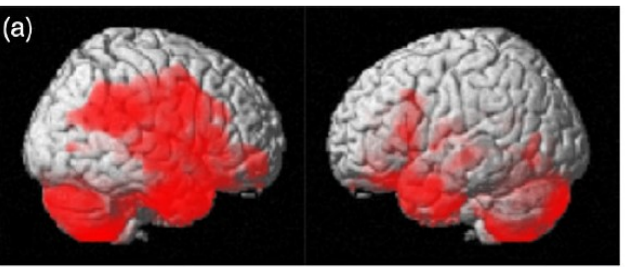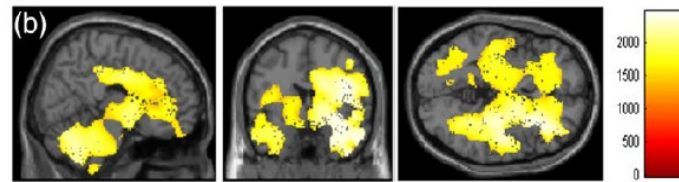- 昼間の眠気が強く、放課後の課外活動時間が少なく、BMIが高い。
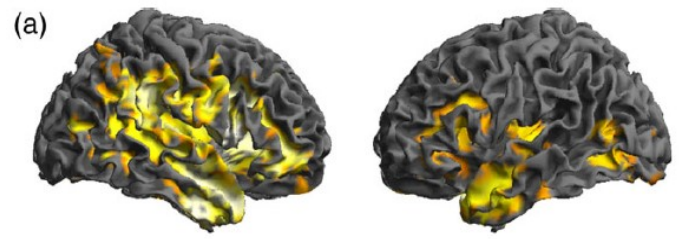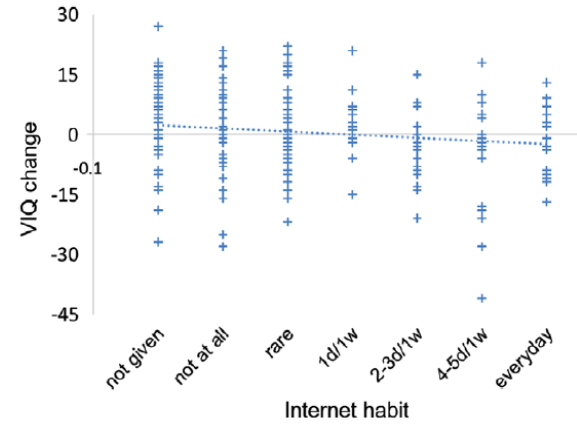
中学生と高校生。
- 朝食抜きが増える。

小学5，6年：便秘傾向。

中学生：成績不良。

高校生：運動日数減少。

ネットの使用頻度が脳構造と言語性知能の発達の及ぼす影響（東北大川島教授グループの研究）

平均年齢11歳前後の223名を約3年間隔で2回知能検査とMRI測定を行い、初回測定時のネット使用頻度（持っていない、やらない、稀に使用、週に1日、週に2-3日、週に4-5日、毎日）と初回検査及び2回の検査の変化との関連を検討した研究。

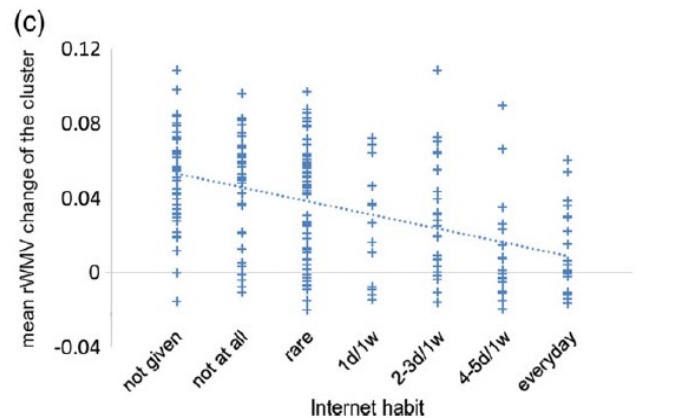**初回測定時には知能検査、MRI検査ともネット時間との間に有意な関連性は見出せませんでした。**

初回検査時にネット使用が多いと、言語性検査IQ（VIQ）と全検査IQが有意に低下（上の図）。

初回検査時にネット使用が多いと、

灰白質（左の図）では、両側のシルビウス溝周辺領域、両側側頭局、両側小脳、両側の海馬と扁桃核、両側基底核、両側側頭葉下部、視床、眼窩前頭回、外側前頭前皮質、島、左舌状回で有意な体積減少が認められ、

白質（右の図）では灰白質の体積減少を認めた部位近傍に加えて、帯状部の体積が有意に減少していた。

ネット使用頻度が高いと、知能検査結果が悪化し、かつ極めて広範な脳領域で神経細胞が占める体積が減ることがわかった。
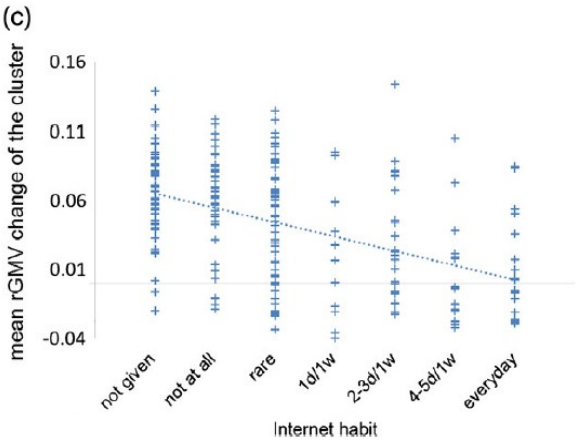
Takeuchi H, et al. Impact of frequency of internet use on development of brain structures and verbal intelligence: Longitudinal analyses. Hum Brain Mapp. 2018;39:4471–4479. https://doi.org/10.1002/hbm.24286

ディスプレイから放出される
ブルーライトの夜間使用の弊害

- 覚醒を高め、
- 夜に浴びると生体時計を遅らせる効果が最大で、
- 夜に浴びるとメラトニン分泌を低下させる効果が最大で、
- ディスプレイに表示される内容は交感神経を刺激する。
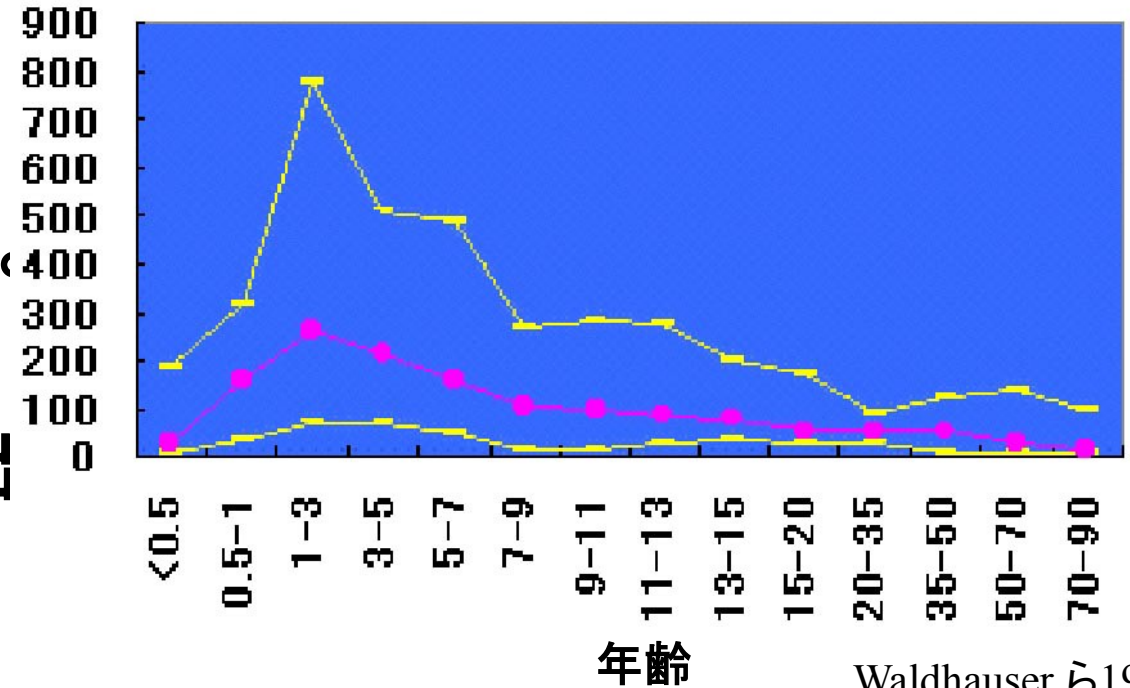
ディスプレイから放出される
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- 覚醒を高め、
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- 夜に浴びるとメラトニン分泌を低下させる効果が最大で、
- ディスプレイに表示される内容は交感神経を刺激する。

メラトニン

- 酸素の毒性から細胞を守り、性成熟を抑制し、
  眠気をもたらすホルモン
- 満期産の母乳栄養児
- 生後6週までは低値（<10pg/ml）
- 生後45日以降
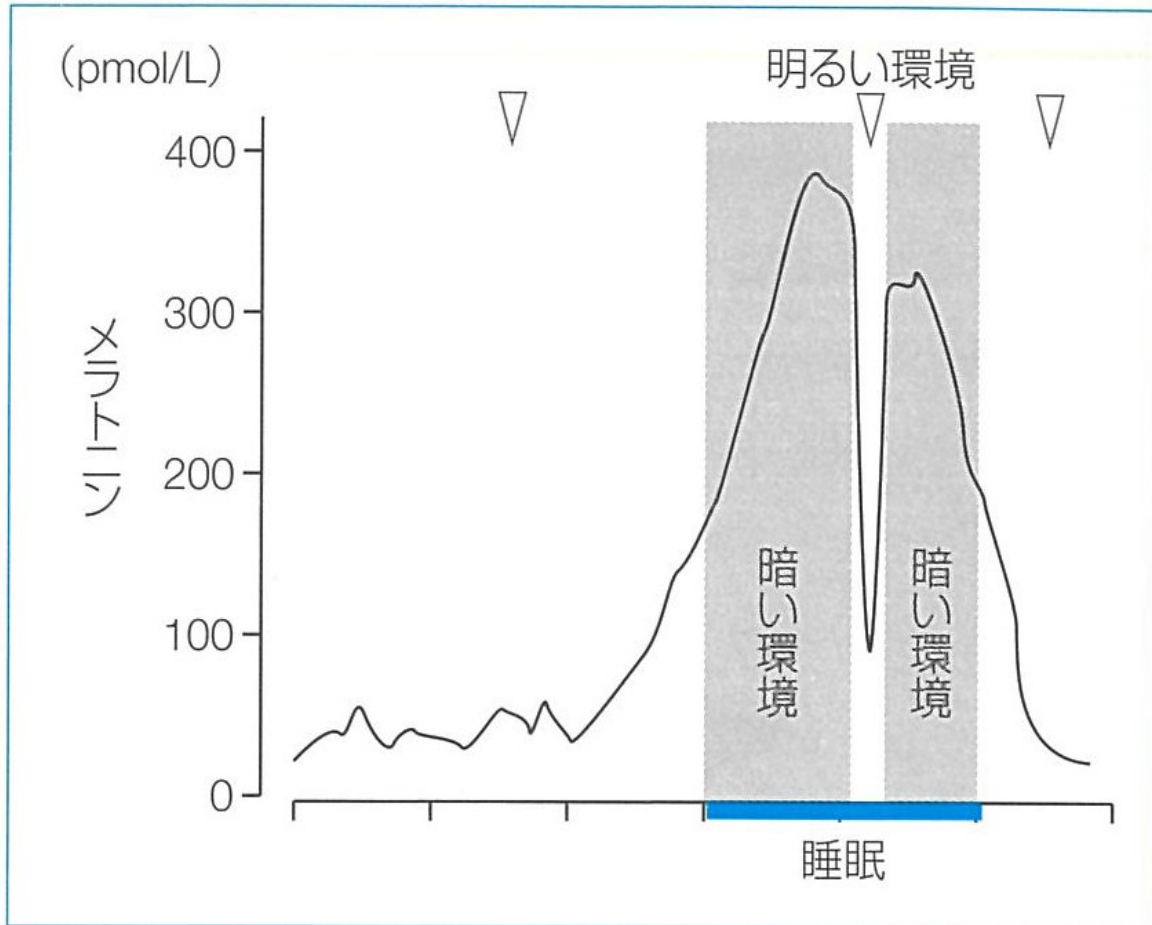 夜間濃度が50<で概日リズム出

- 生後1-5年時に高値
  → 子ども達はメラトニンシャワーを浴びて成長
- 分泌は夜間暗くなってから（光で抑制）。
- 夜ふかしでメラトニン分泌低下！？

900
800
700
600
500
400
300
200
100
0

<0.5 0.5-1 1-3 3-5 5-7 7-9 9-11 11-13 13-15 15-20 20-35 35-50 50-70 70-90

年齢　　　Waldhauser ら1988

Late nocturnal sleep onset impairs a melatonin shower in young children

Jun Kohyama
Department of Pediatrcs, Tokyo Medical and Dental University, JAPAN.

Key words: melatonin; late sleeper; sleep deprivation; antioxidant; melatonin shower

Neuroendocrinology Letters 2002; 23(5/6):385-386　pii: NEL235602L01　Copyright © Neuroendocrinology Letters　www.nel.edu
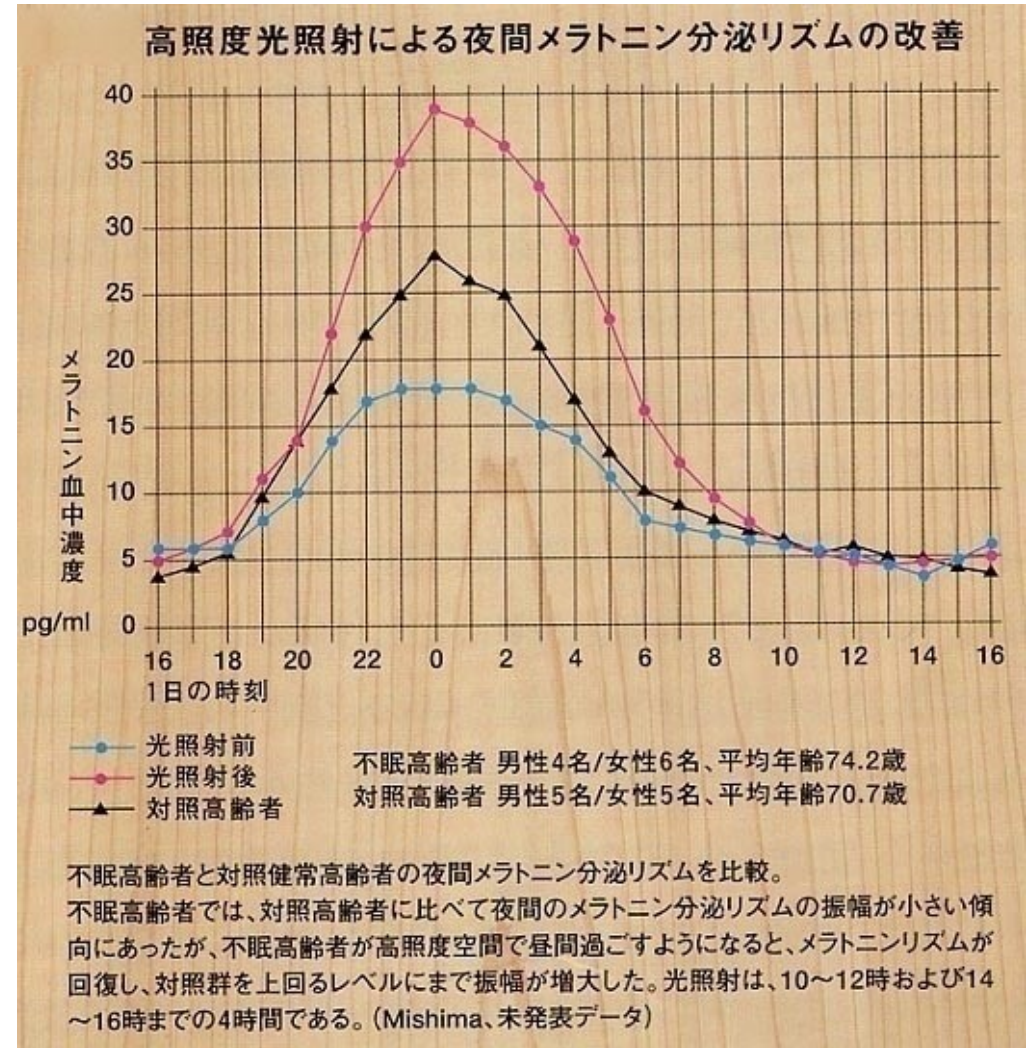
図4-15 メラトニン分泌と光

メラトニン分泌は光で抑制される.

（Lewy AJ, et al. 1980. Light suppresses melatonin secretion in humans. Science 210：1267-9）

高照度光照射による夜間メラトニン分泌リズムの改善

不眠高齢者と対照健常高齢者の夜間メラトニン分泌リズムを比較。
不眠高齢者では、対照高齢者に比べて夜間のメラトニン分泌リズムの振幅が小さい傾向にあったが、不眠高齢者が高照度空間で昼間過ごすようになると、メラトニンリズムが回復し、対照群を上回るレベルにまで振幅が増大した。光照射は、10～12時および14～16時までの4時間である。（Mishima、未発表データ）
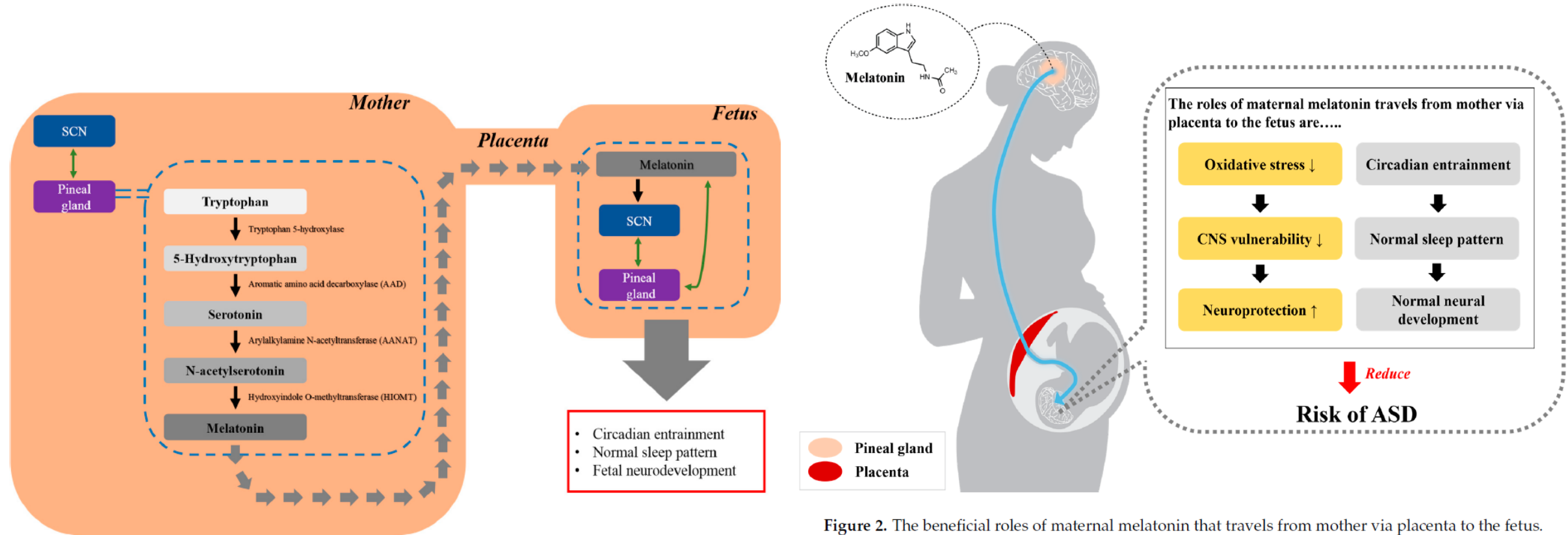
夜間のメラトニン分泌は昼間の
受光量が増すと増える。

The Relationship between Autism Spectrum Disorder and Melatonin during Fetal Development

Yunho Jin [1,2,3], Jeonghyun Choi [1,2,3], Jinyoung Won [2,3,4] and Yonggeun Hong [1,2,3,4,*]

Figure 1. Maternal melatonin crosses the placental barrier to entrain the fetal circadian rhythm. Thus, melatonin is present in the fetal brain prior to the maturation of the fetal pineal gland. After crossing the placenta, melatonin entrains the fetal circadian rhythm, maintains the normal sleep pattern, and protects the fetus from neurodevelopmental disorders such as ASD.

Figure 2. The beneficial roles of maternal melatonin that travels from mother via placenta to the fetus. The functions of melatonin in neuroprotection and circadian entraining may reduce the risk of ASD. Normal melatonin concentrations during pregnancy contribute to neuroprotection and the normal neurodevelopment of the fetus through the inhibition of excessive oxidative stress in the vulnerable central nervous system. Additionally, as adequate melatonin levels maintain the normal sleep pattern and circadian rhythm, normal melatonin secretion may also elicit neurodevelopment.

妊娠中にメラトニン濃度が正常であることで、
脆弱な中枢神経系での過剰な酸化ストレスが抑制され、胎児の神経保護や神経発達が 保証される。

Review
Melatonin and pregnancy in the human

Hiroshi Tamura[a,b], Yasuhiko Nakamura[c], M. Pilar Terron[a], Luis J. Flores[a],
Lucien C. Manchester[a,d], Dun-Xian Tan[a], Norihiro Sugino[b], Russel J. Reiter[a,*]

夜間メラトニンは妊娠週数増（32週以降）で増（＝胎児も増？）
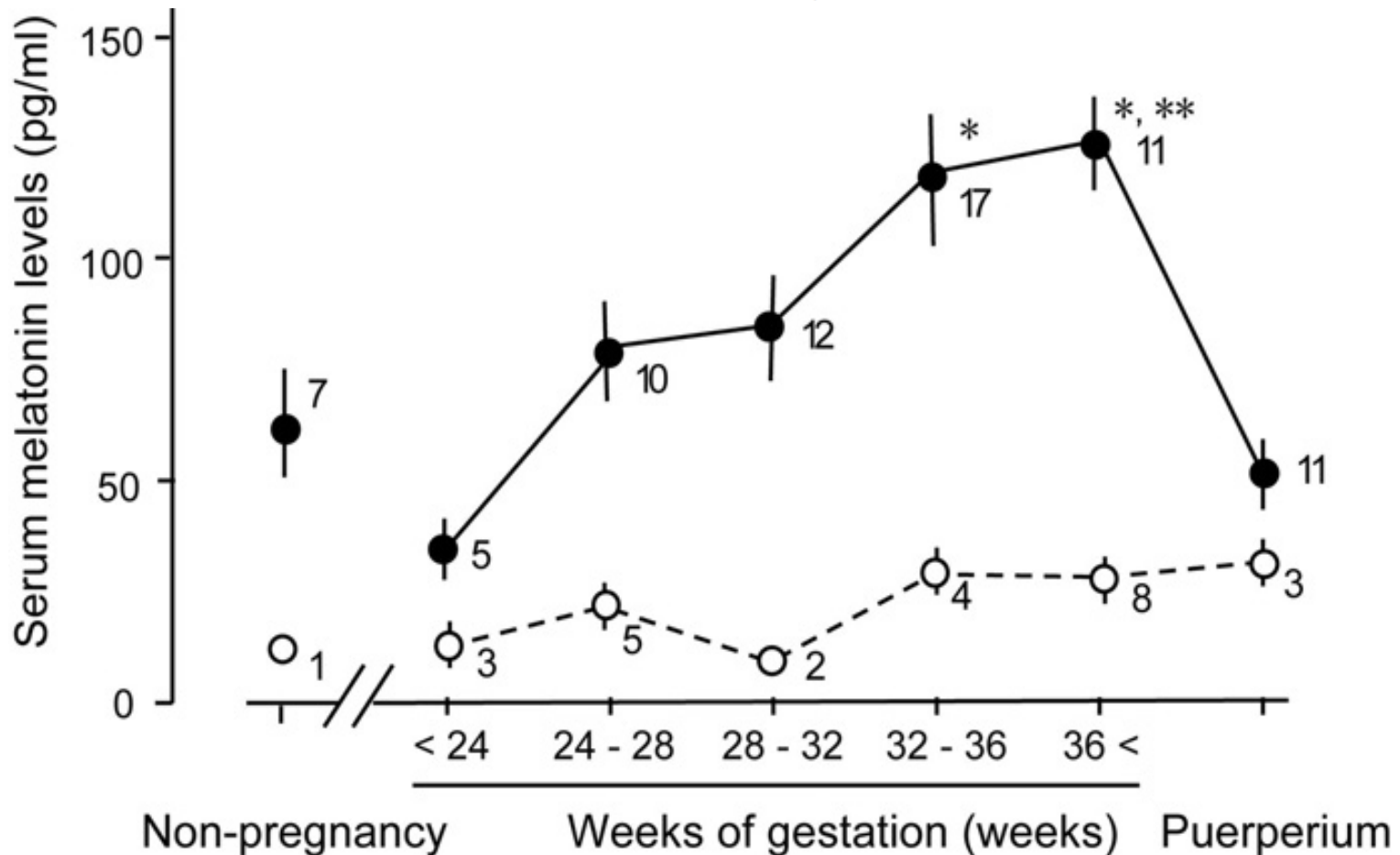
Fig. 1. Levels of maternal serum melatonin during the night (solid line) and day (dotted line) in normal singleton pregnancy. Values aremeans±S.E.M. for the number of patients indicated beside each point. Daytime levels below the lower limit (5.6 pg/ml) of the assay were excluded fromthe analysis. *P < 0.01 compared with the non-pregnancy values, <24-week values, or puerperium values. **P < 0.05 compared with the 24–28-week value. From Nakamura Y, Tamura H, Kashida S, Takayama H, Yagamata Y, Karube A, et al. Changes of serum melatonin level and its relationship to feto-placental unit during pregnancy. J Pineal Res 2001;30:29–33.

メラトニン分泌は昼間の
受光量が増すと増える。

高照度光照射による夜間メラトニン分泌リズムの改善

メラトニン血中濃度 pg/ml

40
35
30
25
20
15
10
5
0

16 18 20 22 0 2 4 6 8 10 12 14 16
1日の時刻

- 光照射前
- 光照射後
- 対照高齢者

不眠高齢者 男性4名/女性6名、平均年齢74.2歳
対照高齢者 男性5名/女性5名、平均年齢70.7歳

不眠高齢者と対照健常高齢者の夜間メラトニン分泌リズムを比較。
不眠高齢者では、対照高齢者に比べて夜間のメラトニン分泌リズムの振幅が小さい傾
向にあったが、不眠高齢者が高照度空間で昼間過ごすようになると、メラトニンリズムが
回復し、対照群を上回るレベルにまで振幅が増大した。光照射は、10〜12時および14
〜16時までの4時間である。(Mishima、未発表データ)
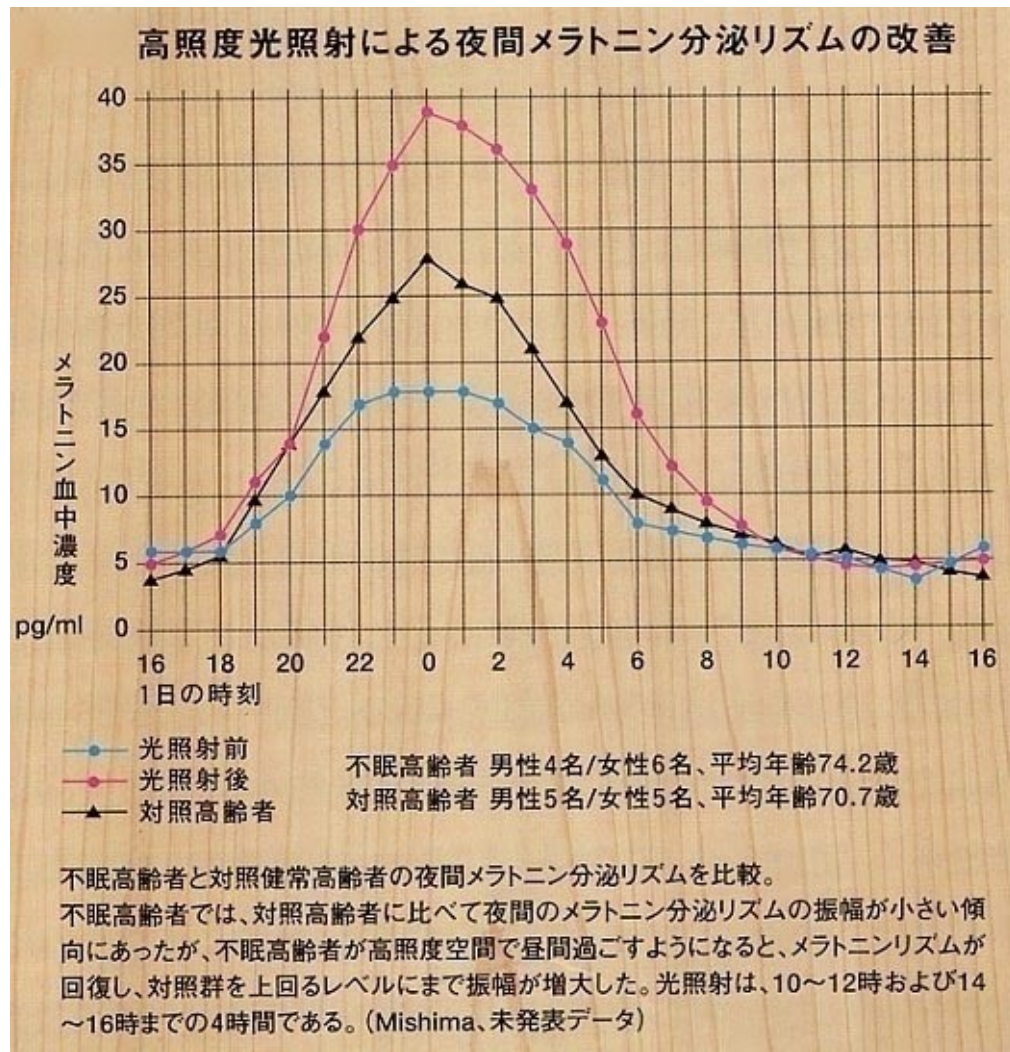
母体の
メラトニンレベル低下は
分娩にも児にも不利！？
その要因は
母体の昼間の受光減と
夜間の受光増！？

論文4.

Lifestyle habits associated with poor defecation habit among pupils in Japan
--Manuscript Draft--

Purpose: Not enough attention has been paid to defecation habits in Japan. This study aimed to emphasize the importance of defecation habits on health and function.Methods: By multiple regression analysis, 2,722 questionnaires obtained from pupils in grades 5 to 12 were analysed to determine lifestyle habits associated with defecation frequency. Results: Significant regression formulae for defecation score were obtained for all school types: elementary school (adjusted R2 = 0.08, P < 0.001), junior high school (0.09, P < 0.001), and high school (0.15, P < 0.001). Female gender was significantly associated with a poorer defecation score in all three school types. In both elementary school and junior high school, breakfast skipping was significantly associated with a poorer defecation score. In both junior and senior high schools, a lower physical activity score was significantly associated with a poorer defecation score. In both elementary school and high school, longer school-day screen time was associated with a poorer defecation score. Poorer self-reported academic performance score in elementary school, less standardised body mass index in junior high school, and shorter non-school-day screen time score in high school were associated with poorer defecation score.Conclusions: Poor defecation frequency showed significant associations with various lifestyle habits, such as breakfast, physical activity, and screen time, among pupils. Academic performance and standardised body mass index were also associated with defecation frequency. More attention should be paid to defecation frequency in terms of sustaining pupils' health and function.

排泄頻度（毎日、1日おき、2－3日おき、週に2回以下）と有意に関連した要素を探った。

子どもの「快眠・快食・快便・快動」を取り戻す

四快のすすめ
よんかい

神山 潤
Kohyama
Jun ＝編
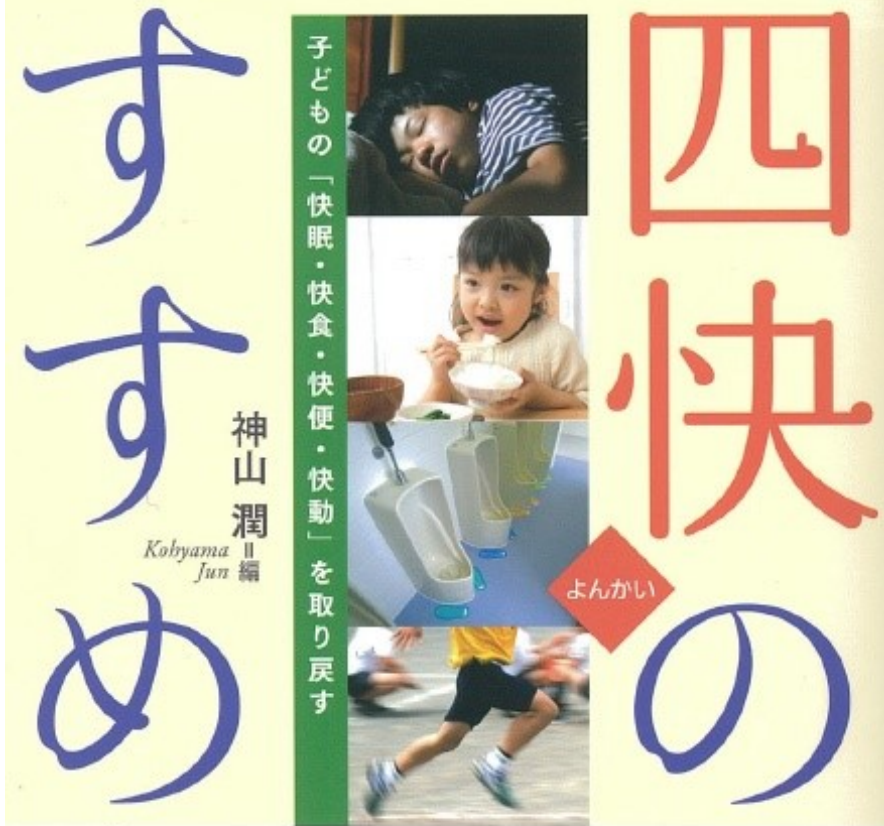
「快」より始めよ！

時代がいかに変わっても「ヒト」は動物。
「身体にいいこと」を忘れてしまった子どもたち親たちへ。

睡眠・食事・運動・排泄など異分野・異業種の研究者・活動家・実践者が結集、
子どもの未来を考える「カッサンドラの会」メンバーによる渾身のメッセージ！

新曜社

「四快のすすめ」は眠りの専門家、食の専門家、排泄の専門家、そして運動の専門家に参加していただいての一冊です。「動物の生存に必要な行動には、快が伴っているに違いない」、ということから出発した発想で、寝る、食べる、出す、動く、という行為はどれも快を伴います。だからこれらの行動はヒトという動物の生存に有利に働くに違いありません。そこでこれらの行為、そして快を大切にしよう、という趣旨に賛同してくださった皆さんのご協力で出来上がった一冊でした。ただその時から出版社には「四」というのはどうも出版物には適していない、ぜひ七か八にして欲しい、といわれていたのでした。そして最近になってようやくほぼ決めることができました。**一つは笑う快、二つ目は泣く快、三つめは遊ぶ快、そして四つ目は識る快**です。最初の四快にあった**動については、さまざまな理由で身体を動かせない方もおいでなので、八快には含めますが、七快には含めないようにしようと思っています。**生きるに必須な生理現象である、寝る、食べる、出す。辺縁系に由来する、笑う、泣く。そして皮質に由来する、遊ぶ快と識る快。これらをあわせての七快で、これに動くを含めると八快です。

Table 2. Number of pupils in each defecation score category in each school type

School types; number (M/F)	DF1 Number (M/F) % in each school type (M/F)	DF2 Number (M/F) % in each school type (M/F)	DF3 Number (M/F) % in each school type (M/F)	DF4 Number (M/F) % in each school type (M/F)
ES; 956 (441/515)	585 (311/274) 61.2% (70.5%/53.2%)	217 (78/139) 22.7% (17.7%/27.0%)	124 (45/79) 13.0% (10.2%/15.3%)	30 (7/23) 3.1% (1.6%/4.5%)
JHS; 1,049 (541/508)	585 (344/241) 55.8% (63.6%/47.4%)	236 (109/127) 22.5% (20.1%/25.0%)	173 (70/103) 16.5% (12.9%/20.3%)	55 (18/37) 5.2% (3.3%/7.3%)
HS; 717 (385/332)	460 (295/165) 64.2% (76.6%/49.7%)	141 (63/78) 19.7% (16.4%/23.5%)	82 (24/58) 11.4% (6.2%/17.5%)	34 (3/31) 4.7% (0.8%/9.3%)
Total; 2,722 (1367/1355)	1,630 (950/680) 59.9% (69.5%/50.2%)	594 (250/344) 21.8% (18.3%/25.4%)	379 (139/240) 13.9% (10.2%/17.7%)	119 (28/91) 4.4% (2.0%/6.7%)

Defecation score showed the frequency of defecation, and pupils belonged to defecation score 1 (DF1) with defecation every day, DF2 every other day, DF3 once every two to three days, DF4 twice a week or less. ES: elementary school; JHS: junior high school; HS: high school. M: male; F: female.

排泄指数高値と有意に関連したのは、
　　小中高とも女性、
　　小中では朝食欠食、
　　小高では登校日のスクリーン時間の長さ、
　　中高では運動の少なさ、
　　小学生では自己申告した成績不良
　　中学生ではBMI低値
　　高校生では休日のスクリーン時間の短さ

論文5. Pupils with negative social jetlag in Japan are hypothesised to constitute a discrete population

きっかけは少年野球で中1なのにレギュラーになった男の子。
主訴は授業中の眠気。
毎日21時までの練習に加え、毎週末は5時起きで遠征。
寝なきゃダメとはわかってもいました。
野球と勉強どっちとるのと聞いたら、答えは野球。
じゃ、授業中寝なさい、と神山。

Table 2
SJL category distributions in each school type.

	SJL-I (< 0 h) (range; −4.5 to −0.25)	SJL-II (0–1 h) (reference)	SJL-III (1–2 h)	SJL-IV (2 h= <) (range; 2–4.5)
Total (M/F)	114 (76/38)	1,194 (659/535)	1,078 (469/609)	336 (163/173)
2,722 (1,367/1,355)	4.2%	43.9%	39.6%	12.3%
ES	36 (25/11)	491 (270/221)	368 (123/245)	61 (23/38)
956 (441/515)	3.8%	51.4%	38.5%	6.4%
JHS	53 (38/15)	422 (221/201)	437 (216/221)	137 (66/71)
1,049 (541/508)	5.1%	40.2%	41.7%	13.1%
HS	25 (13/12)	281 (168/113)	273 (130/143)	138 (74/64)
717 (385/332)	3.5%	39.2%	38.1%	19.2%

平日よりも週末に遅寝遅起きのSJL-III, SJL-IVは運動は少なく、休日のスクリーン時間が長く、睡眠時間も長かった。
休日に早起きのSJL-Iは男子が多く、課外活動が多く、運動が多く、休日のスクリーン時間が短く、睡眠時間が短かった。
少なくとも日本のSJL-Iは特異な一群を形成している可能性がある。

肥満は不幸！？

・ギャラップ社の幸福度調査；
1位はフィジー：肥満率は31.9％
（189カ国中23位、日本は4.5％166位）

ピダハンは昼も夜もよくうたた寝をする（短いときで15分、長ければ2時間ほどだ）。村では夜通し、大きな話し声がしていて、外から来た人間はピダハンの中ではなかなかぐっすり眠れない。ピダハンは「寝るなよ、ヘビがいるから」と忠告してくれるのだが、ピダハンは実際自分たちもこの忠告に忠実に従っているのだろう。

Take Home Message
（最近職員に伝えていること）

医療職なら

寝るのも仕事！