Sleep in adolescence

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- **PEDIATRIC SLEEP COURSE**
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Changes seen in adolescence

- Physical changes (puberty)

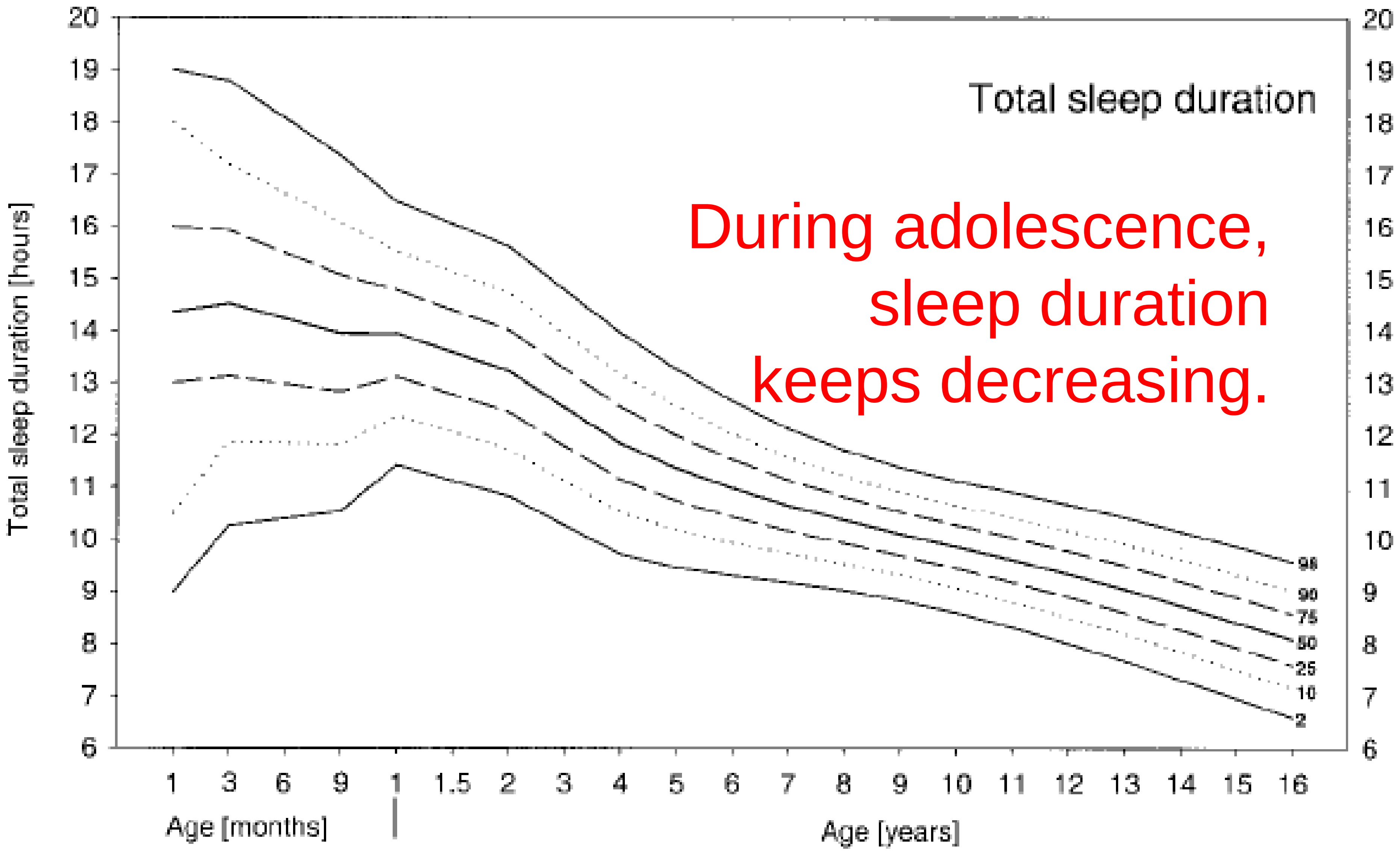
  rapid physical growth

  growth of under-arm, body and pubic hair.

  For girls: menstrual periods,

  For boys: voice breaks (becomes deeper),

  growth of facial hair, erections and wet dreams.
- Psychological, emotional, behavioral, etc
- These changes have mainly been based on endocrinological alterations.



Sleep Duration From Infancy to Adolescence: Reference Values and Generational Trends

Ivo Iglowstein, Oskar G. Jenni, Luciano Molinari and Remo H. Largo

Pediatrics 2003;111;302-307

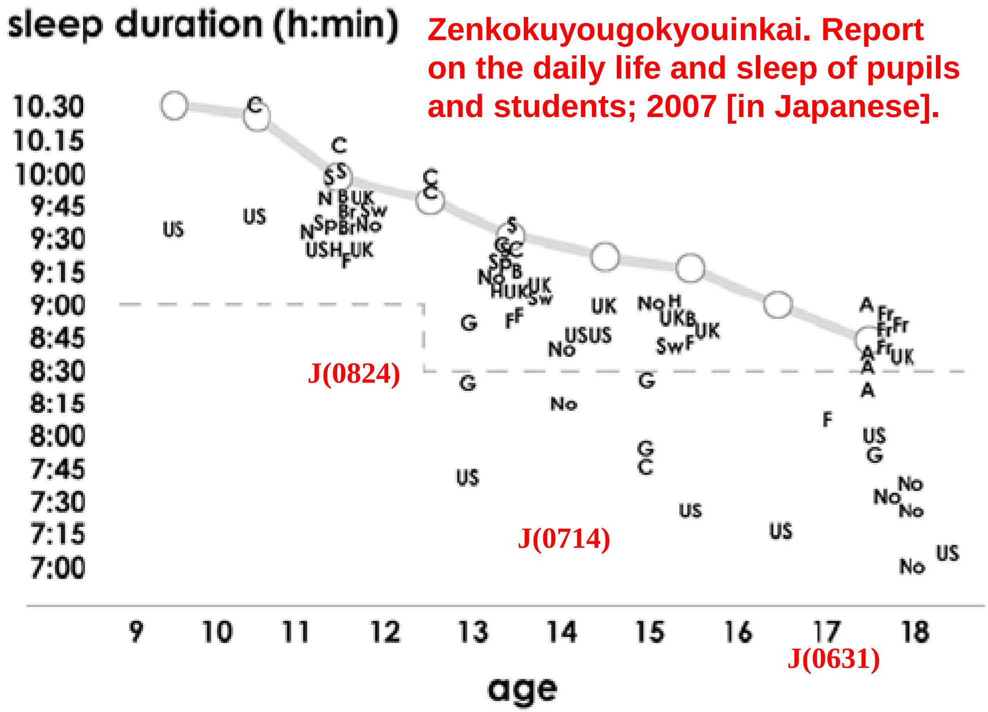


Figure 2—Comparison of school day sleeping times of young Australians from the current study (large dots, grey line) with recent data from other studies in developed countries. Note that in some cases, the number of data points for a country exceeds the number of studies conducted in that country because sleep duration data were presented separately for gender and/or region subsets. The dotted grey line represents the recommended sleep requirements according to the Centers for Disease Control and Prevention.

A, Australia[18]; B, Belgium[39]; Br, Brazil[42]; C, Canada[43,44]; F, Finland[39,45]; Fr, France[46]; G, Germany[47]; H, Hungary[39]; N, Netherlands[48]; No, Norway[39,49]; S, Switzerland[39,50]; Sp, Spain[39]; Sw, Sweden[39]; UK, United Kingdom[39,51,52]; US, United States.[12,53-56]

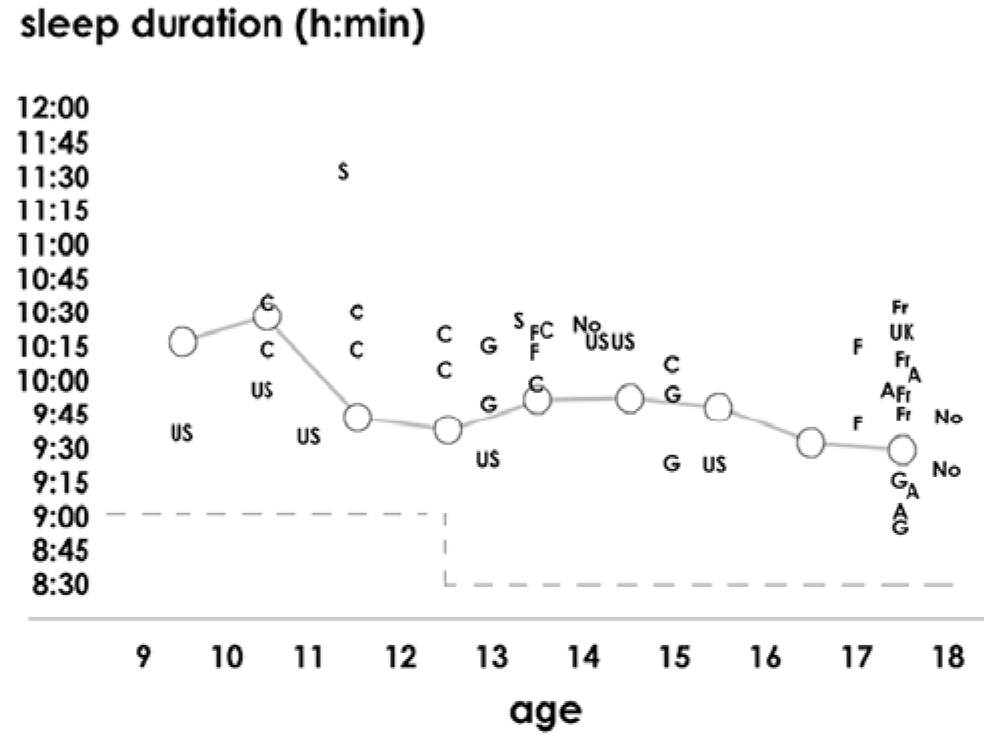


Figure 3—Comparison of non-school day sleeping times of young Australians from the current study (large dots, grey line) with recent data from other studies in developed countries. Note that in some cases, the number of data points for a country exceeds the number of studies conducted in that country because sleep duration data were presented separately for gender and/or region subsets. The dotted grey line represents the recommended sleep requirements according to the Centers for Disease Control and Prevention.

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During adolescence, sleep duration keeps decreasing.

Sleep, 2(4):453–460

Pubertal Changes in Daytime Sleepiness

*,†Mary A. Carskadon, *,†Kim Harvey, ‡Paula Duke,
†Thomas F. Anders, ‡Iris F. Litt, and *,†William C. Dement

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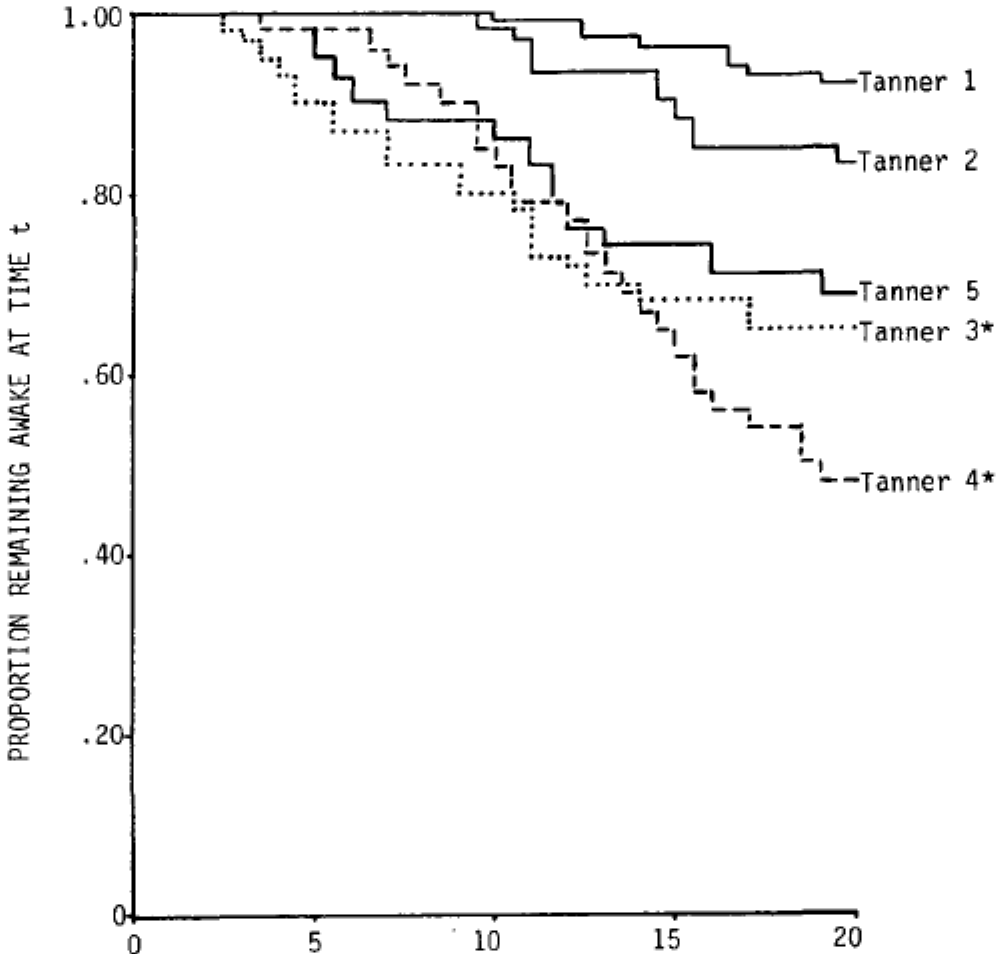
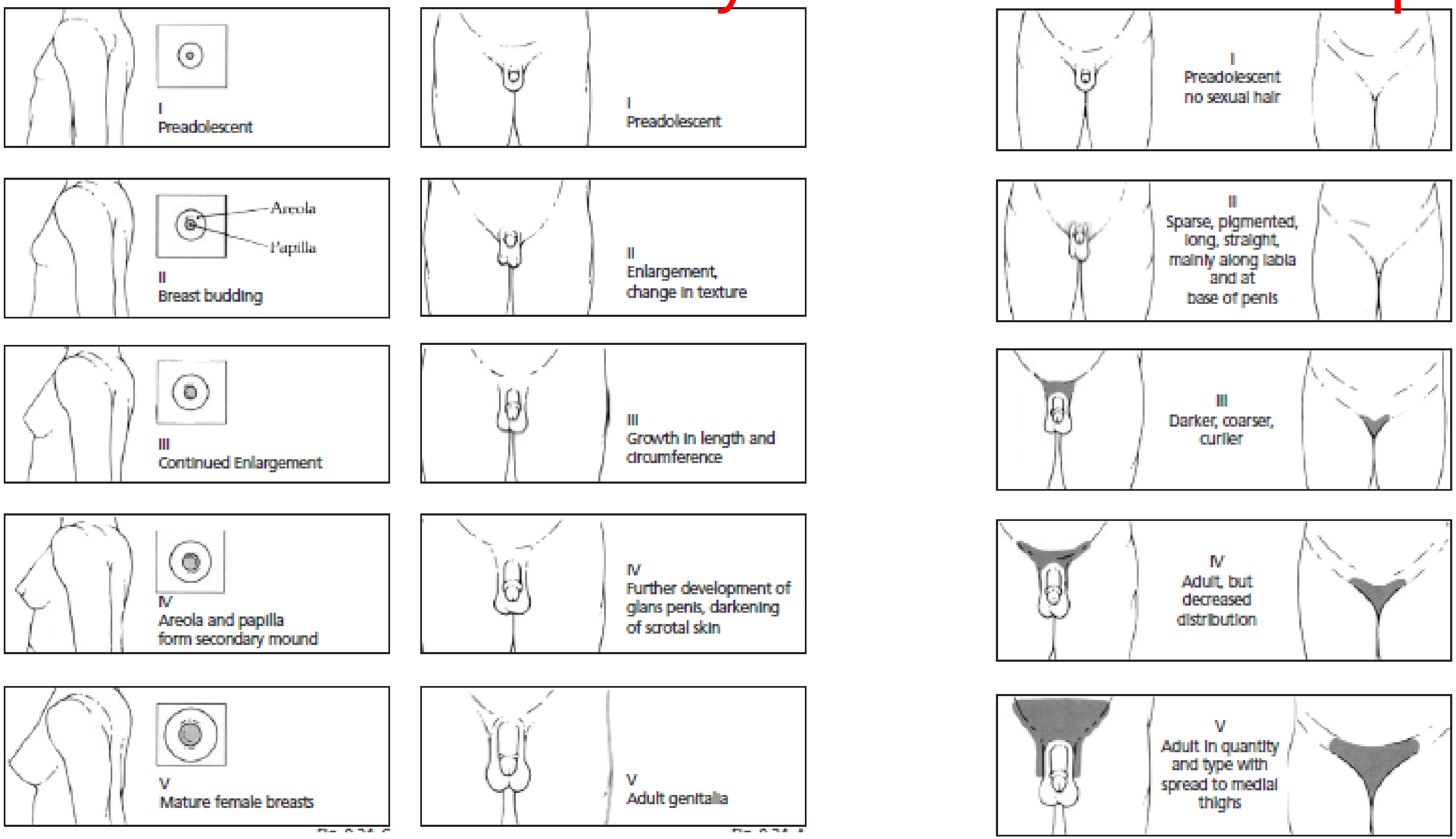


Relation of sleep latency test scores to Tanner stage. The horizontal axis represents the clapsed time from “lights out” to stage 1 sleep onset. The vertical axis gives the proportion of the group who remained awake at a given time after lights out. Thus, for example, Tanner stage 1 subjects did not fall asleep on 92% of the tests, while Tanner stage 4 subjects remained awake the full 20 min on only 48% of the tests.

Physical markers of the puberty.

The Tanner Stages



Source:

Reprinted with permission from Feingold, David. "Pediatric Endocrinology" In *Atlas of Pediatric Physical Diagnosis, Second Edition*, Philadelphia. W.B. Saunders, 1992, 9.16-19

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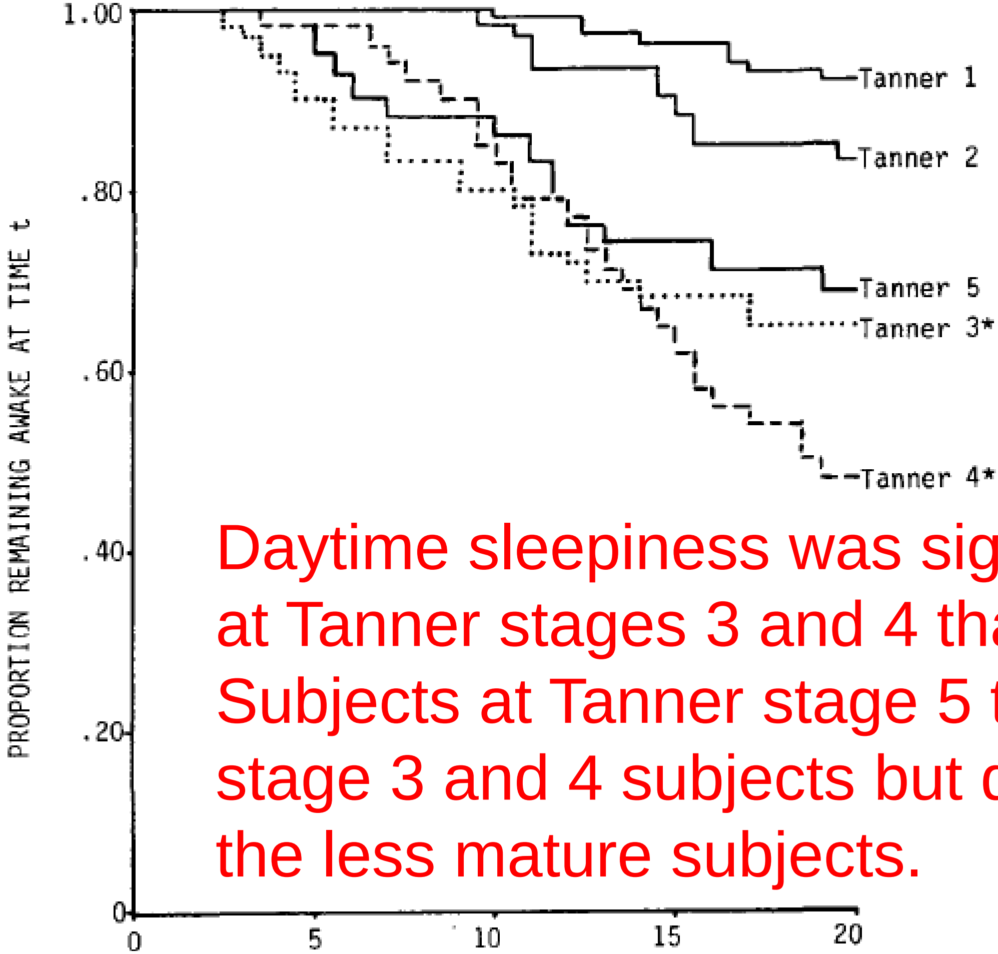

Daytime sleepiness was significantly greater in subjects at Tanner stages 3 and 4 than at Tanner stages 1 and 2. Subjects at Tanner stage 5 tended to be sleepy as Tanner stage 3 and 4 subjects but did not differ significantly from the less mature subjects.

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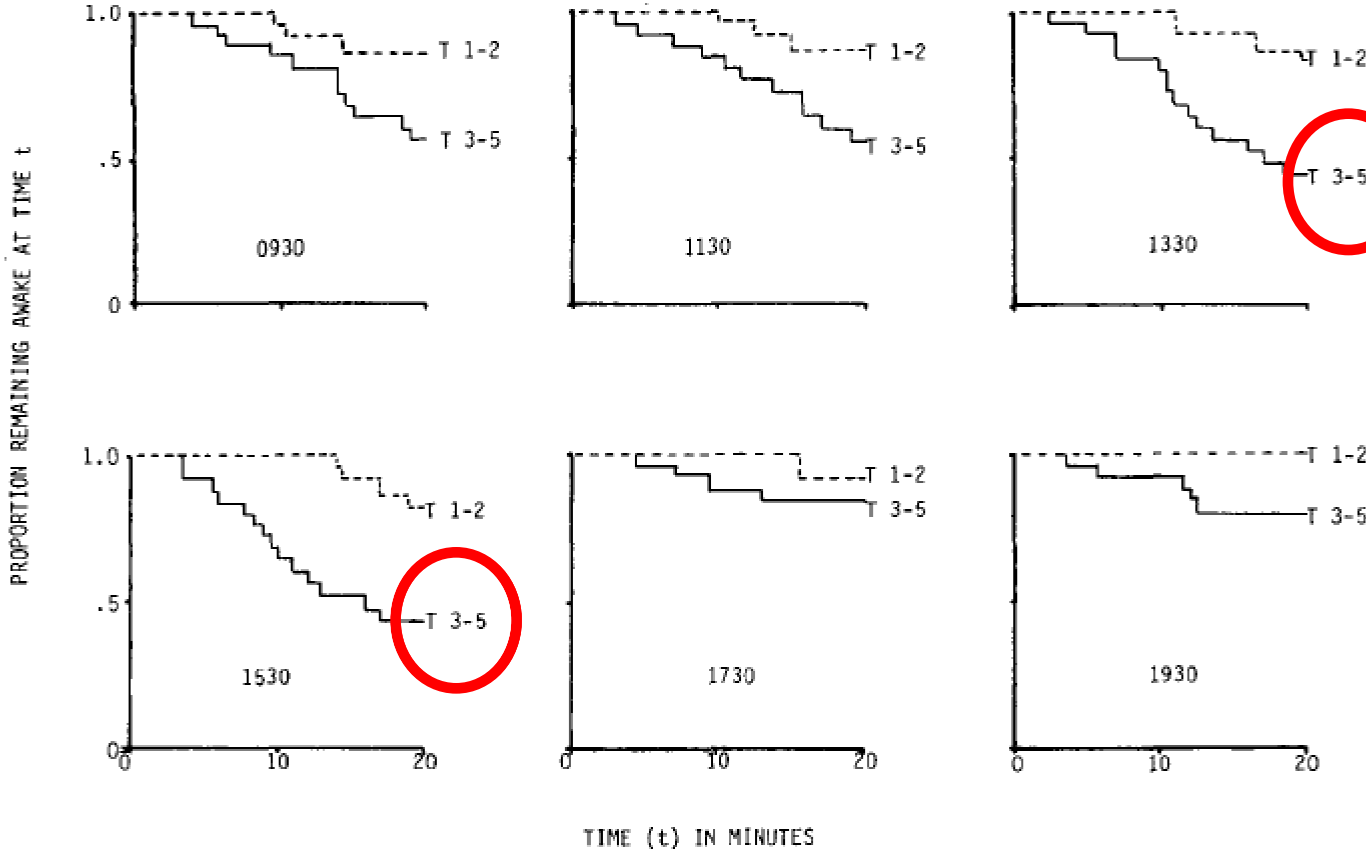

Sleep, 2(4):453–460
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Pubertal Changes in Daytime Sleepiness

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More mature children were significantly sleepier at 1330 and 1530 than in The late afternoon (1730) and evening (1930).

No gender differences were found in daytime sleepiness for children at similar Tanner stages.

Sleep latency test scores across the day. Tanner 3-5 subjects fell asleep faster across days, although the differences were significantly only at 1330 and 1530 hr. In Tanner 3-5 subjects, sleep onsets Occurred earlier and more frequently on the tests at 1330 and 1530 hr than at 1730 or 1930 hr.

Adolescent Changes in the Homeostatic and Circadian Regulation of Sleep

M.H. Hagenauer[a, b] J.I. Perryman[a] T.M. Lee[a–c] M.A. Carskadon[d, e]

Dev Neurosci 2009;31:276–284

Table 1. A delay in circadian phase has been observed around the time of puberty in six mammalian species

	Species					
	human (*Homo sapiens*)	rhesus monkey (*Macaca mulatta*)	degu (*Octodon degus*)	laboratory rat (*Rattus norvegicus*)	laboratory mouse (*Mus musculus*)	fat sand rat (*Psammomys obesus*)
Magnitude of delay	1–3 h	2 h	3–5 h	1–4 h	1 h?	0–3 h under a long photoperiod*, 10–14 h under a short photoperiod
Sex difference	males > females	only females examined	males > females	males > females	only females examined	sex unspecified
Rhythms delayed	sleep, melatonin	activity	activity, sleep?	activity	activity, corticosterone, temperature?*	oxygen consumption, temperature
No. of experiments	>20	1	6	4	2	1
Age of peak delay	15–21 years	39 months	80–100 days	30–40 days	unknown, but delay evident at 35–45 days	unknown, but delay evident at 35–42 days
Age of establishing overt cyclicity in females	menarche: 12–13 years regular ovulation: 13–16 years [21]	menarche: 30–33 months first ovulation: 42–45 months [12]	cycles in vaginal opening: 35–150 days [13, 16]	first ovulation: 35–45 days [22]	first ovulation: 27–40 days regular ovulation: 30–80 days [23–24]	unknown
Age of establishing spermatogenesis	12–16 years [21]	n/a	60–120 days [13]	45–65 days [22]	n/a	28–56 days [25]

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The delayed timing of sleep during human adolescence is likely to represent a developmental change common across mammalian species.

Table 1. A delay in circadian phase has been observed around the time of puberty in six mamm

Age of peak delays are just before (rat) or after(human, monkey, degu, sand rat) the age of the beginning of overt cyclicity or spermatogenesis.

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Magn					1 h?	
Sex d					only exan	
Rhythms delayed	sleep, melatonin	activity	activity, sleep?	activity	activ temperature?	temperature
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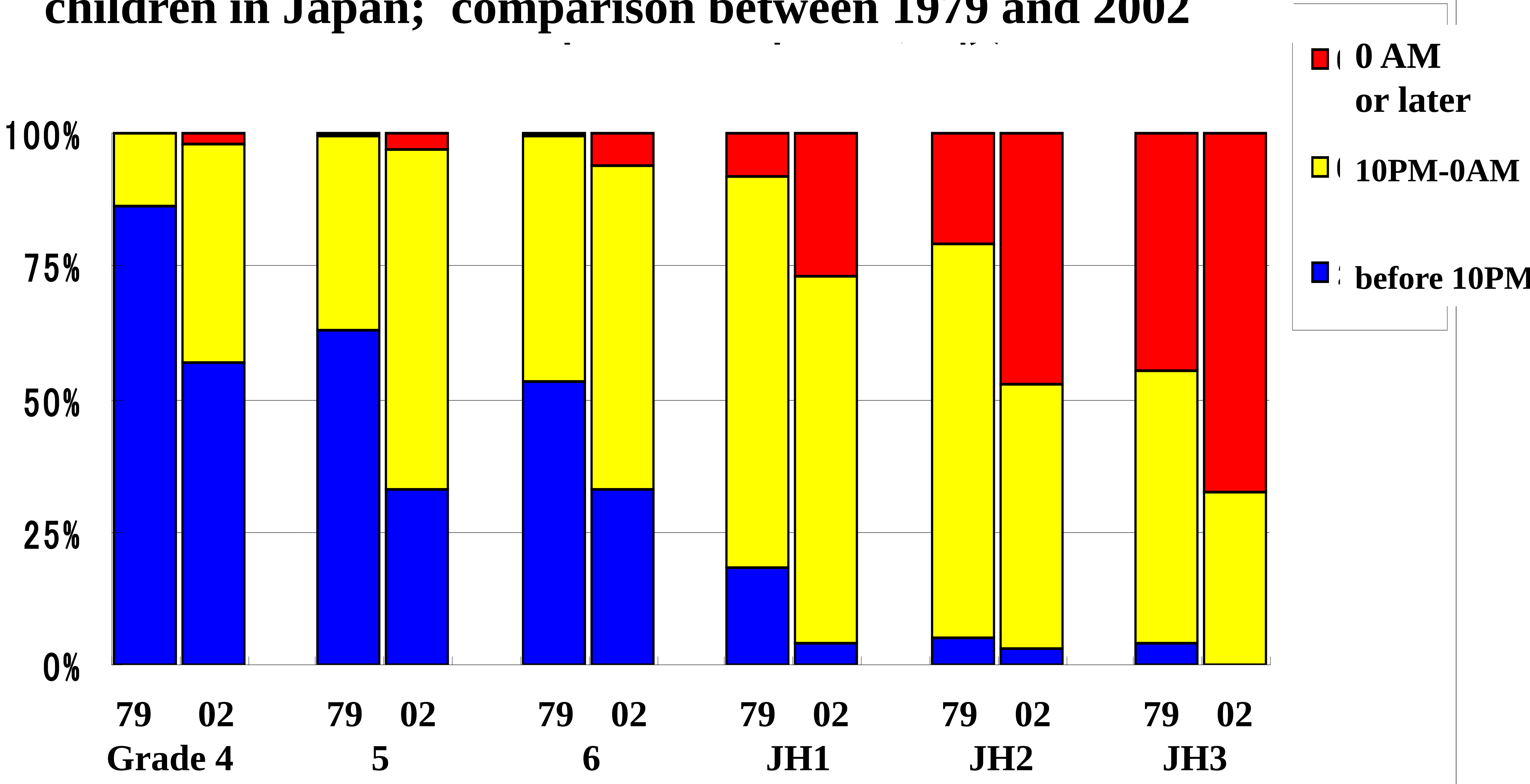
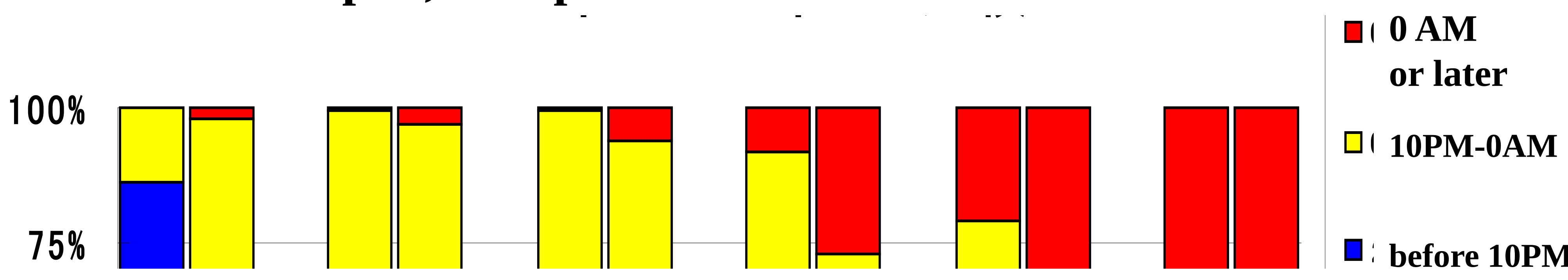
Changes of bedtime of elementary and junior high school children in Japan; comparison between 1979 and 2002



Tokyo Sogo Kyouiku Center 2004･3

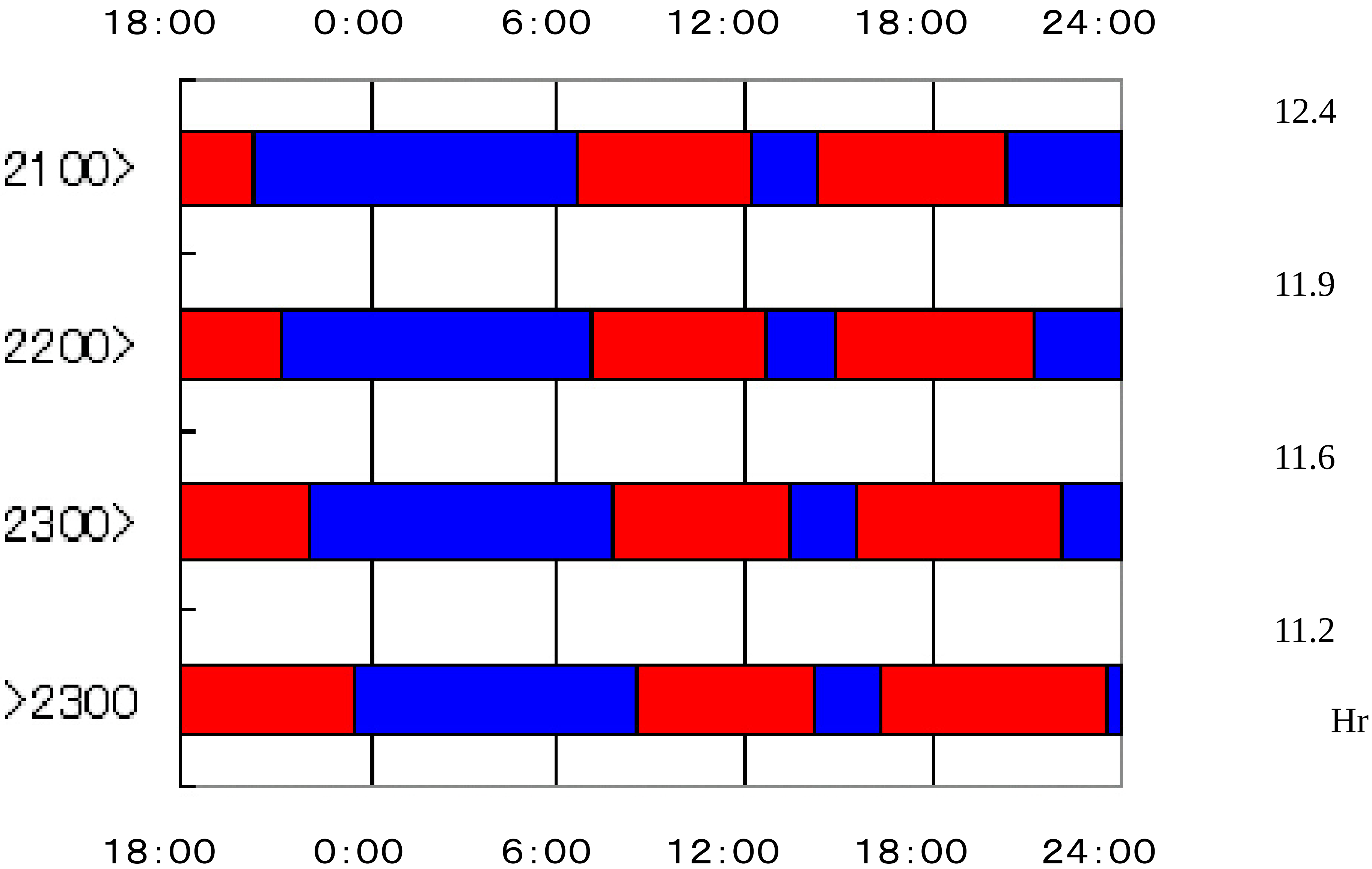
Changes of bedtime of elementary and junior high school children in Japan; comparison between 1979 and 2002



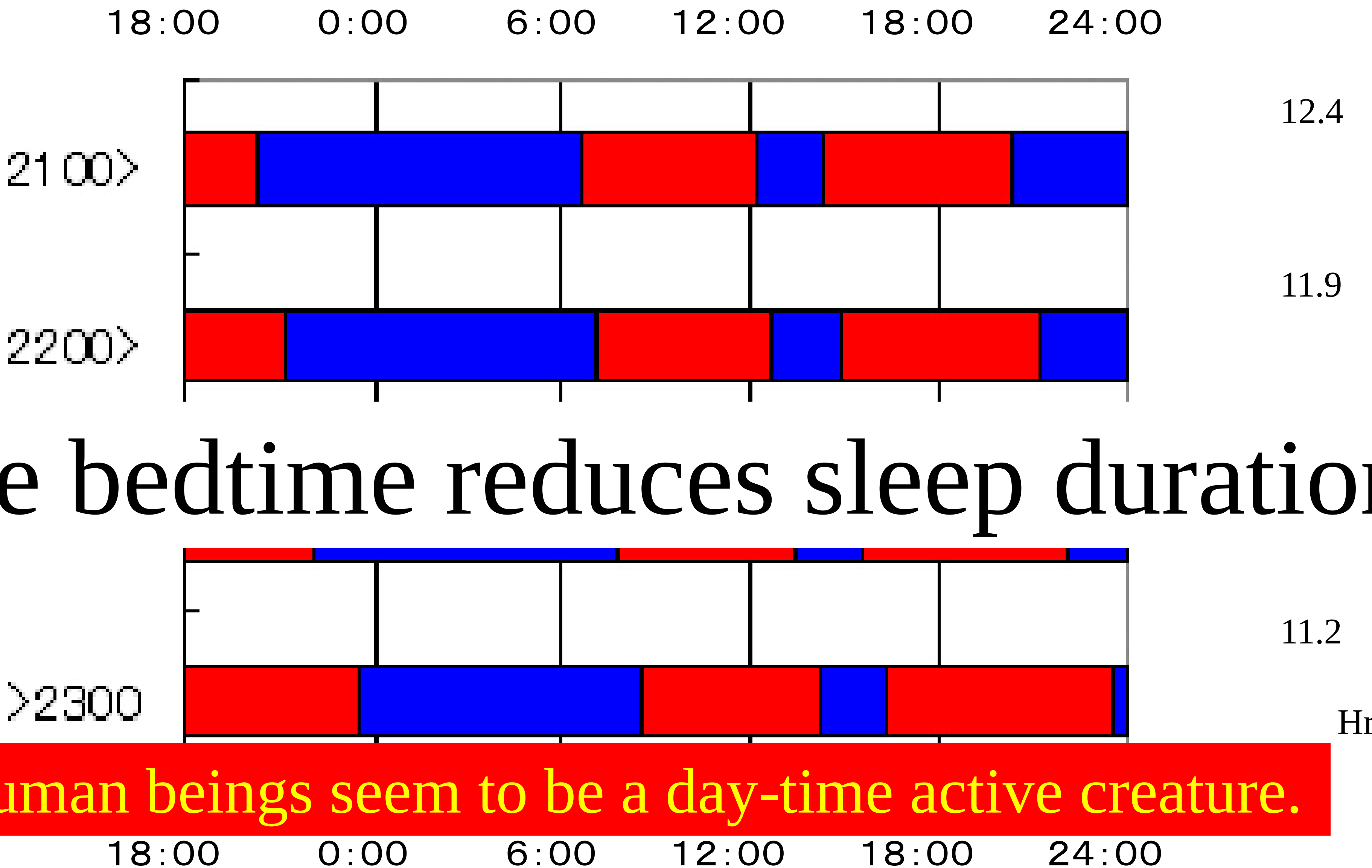
The delayed bedtime is progressing recently.
Sleep of adolescence may not only be affected by biologically, but also by externally (the society?).

Reports (yr)	Objects	Eveningness is associated with・・・・・
Yokomaku et al (2008)	4-6 yrs, n=138	Problematic behaviors
Giannotti et al（2002）	Italian High School students, n=6631	Poor performance, attention deficits, irritability
Wolfson et al (2003)	Students from junior high to university	Poor performance
Gau et al（2004）	Taiwan grade 4-8, n=1572	Moodiness especially in boys
Harada（2004）	Kochi (Japan), junior high school students, n=613	Irritablity
Caci et al（2005）	France, students, n=552	Impulsivity
Gaina et al（2006）	Toyama (Japan), junior high school students, n=638	Daytime sleepiness
Gau et al（2007）	Taiwan, 12-13 yrs, n=1332	Suicide attempt
Susman et al（2007）	USA, 8-13yrs, n=111	Male; conductive disorders, femal,;agrressiveness
Straif et al, 2007		Carcinogenecity

Sleep-wakeful cycles of 18-months-old infants



Sleep-wakeful cycles of 18-months-old infants



Late bedtime reduces sleep duration.

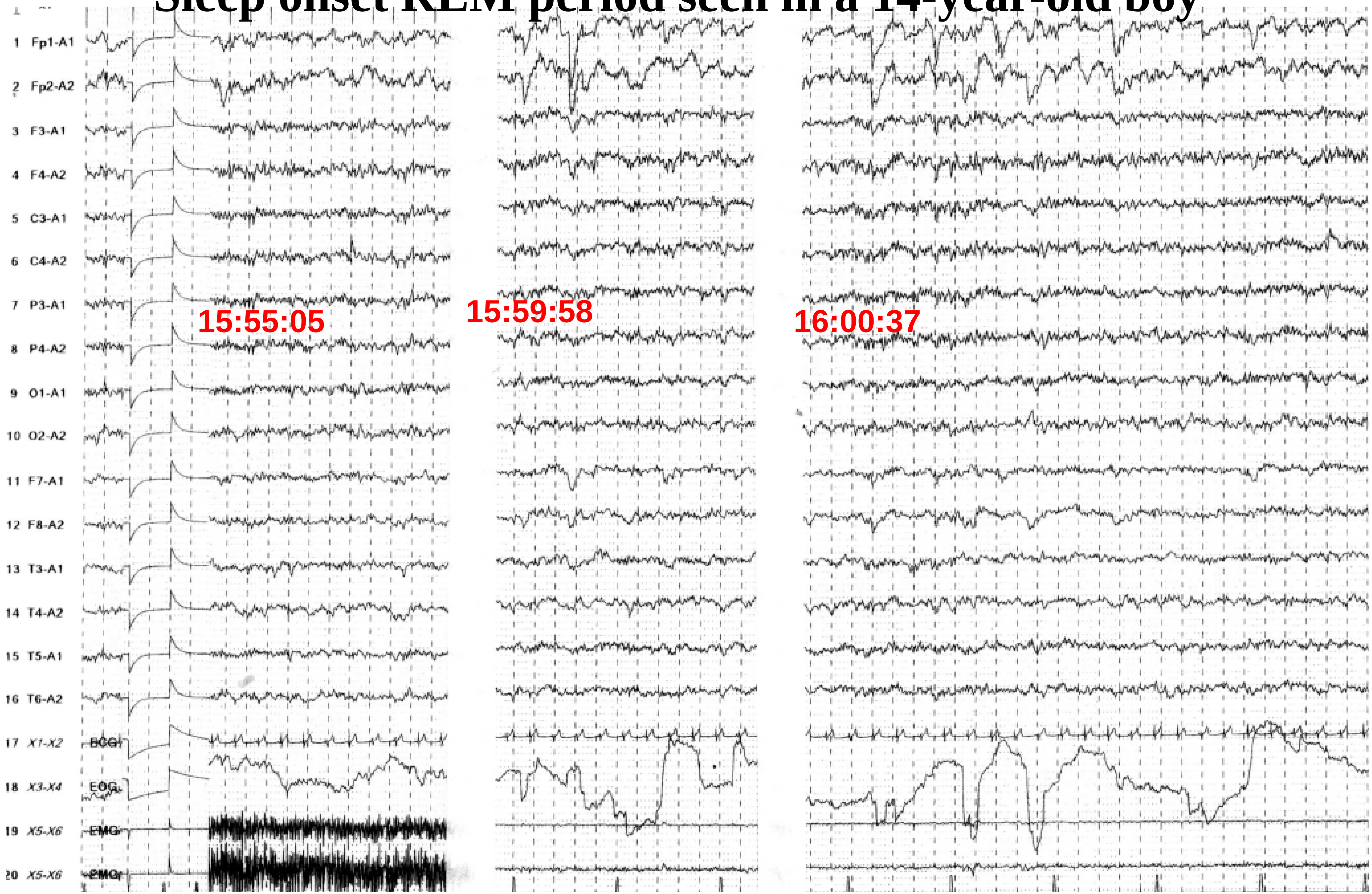
Human beings seem to be a day-time active creature.

Sleep loss produces a negative effect on

- daytime functions,
- general well being,
- metabolic and endocrine function,
- body weight,
- viral infections, and
- psychomotor vigilance, including mood.

- A 14-year-old boy visited my office with a complaint of daytime sleepiness.
- Since the spring vacation at age 8 years, he has suffered from daytime sleepiness, though he had enough night time sleep.
- He lost his power after laughing, and he often wriggled when he was in high.
- I ordered a routine EEG with EOG and EMG recordings.

Sleep onset REM period seen in a 14-year-old boy



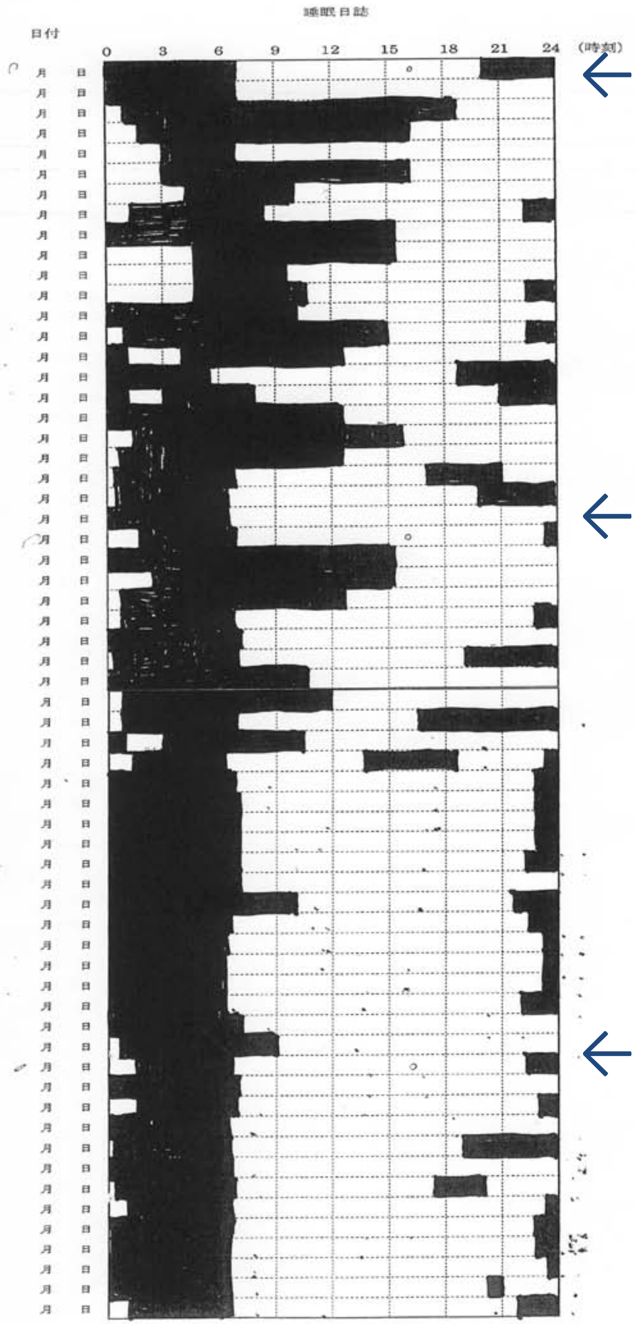
- We found sleep onset REM period on a routine EEG with additional EOG and EMG monitorings.
- Orexin level in his CSF was extremely low (undetectable; less than 40 pg/mL).
- I diagnosed him as having narcolepsy.
- Now he is on modafinil and enjoying his high school life.

- A 13-year-old girl visited my office with a complaint of daytime sleepiness.
- She had an experience of falling into sleep during examination.
- Since she was obese (161cm, 90kg), PSG was performed to assess her respiratory status, but sleep apnea was denied.

- She said she could be alert during daytime, when she had enough sleep.
- She confessed that she used cellular phone until late during night.
- She said to me to try to go to bed before 0 AM, but she could not keep this word.
- Her cellular phone was picked up by school teachers, because she used it against the school rule.
- After this, her daytime sleepiness was disappeared.
- I diagnosed her as having **behaviorally induced insufficient sleep syndrome due to inadequate sleep hygiene.**

- A 17-year-old boy visited my office with a complaint of inability to wake-up in the morning.
- Without trigger, he found it difficult to wake-up in the morning for these several months.
- Sometime, he went to bed at midnight and had a 20-hour sleep.
- Sometime, he took meals twice during midnight.

Sleep log ←; visit to my office



- I asked him to record sleep log.
- The log revealed the irregular rhythm.
- I explained him sleep health.
- He tried to take regular meals, and decided not to use PC during night.
- He recognized that he could wake-up in the morning after he went to bed early in the night.
- I diagnosed him as having behaviorally induced insufficient sleep syndrome due to inadequate sleep hygiene.
- This boy patient was different from the former girl patient, because he recognized his abnormality by himself, and could improve this abnormality by himself.
- Though I do not deny the importance of actigraphy to assess sleep-wakeful rhythm, sleep log written by him/herself has potential therapeutic effects similar to CBT.

- **Proper intervention to patients with behaviorally induced insufficient sleep syndrome due to inadequate sleep hygiene is not to prescribe sleeping pills but to provide sleep health.**

Sleep health; basic four principles

- 1. Increase exposure to morning light.
- 2. Engage in physical activity during daytime.
- 3. Sleep in the dark during the night (*i.e.*, turn off all artificial lighting).
- 4. Eat regular meals.

In addition; Avoid substances that disturb sleep (*e.g.,* caffeine, alcohol, nicotine), and avoid excessive media exposure (*e.g.*, video games, computers, television).

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We can also help teenagers gain control over their own sleep patterns by teaching sleep and circadian principles in middle and high school health education. Minimizing exposure to light at night, as well as reducing computer or TV usage immediately before bedtime can naturally advance circadian phase. Similarly, incorporating outdoor morning activity into a teenage schedule can reduce trouble falling asleep at night.

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By Jun Kohyama, MD, PhD

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Take home message

Tell adolescents importance of sleep health.

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