



TOKYO BAY  
MEDICAL CENTER

# The adolescent asynchronization

By Jun Kohyama, MD, PhD

from Tokyo Bay Urayasu/Ichikawa Medical Center, Japan

## Symposium on THE ADOLESCENT SLEEP DEPRIVED

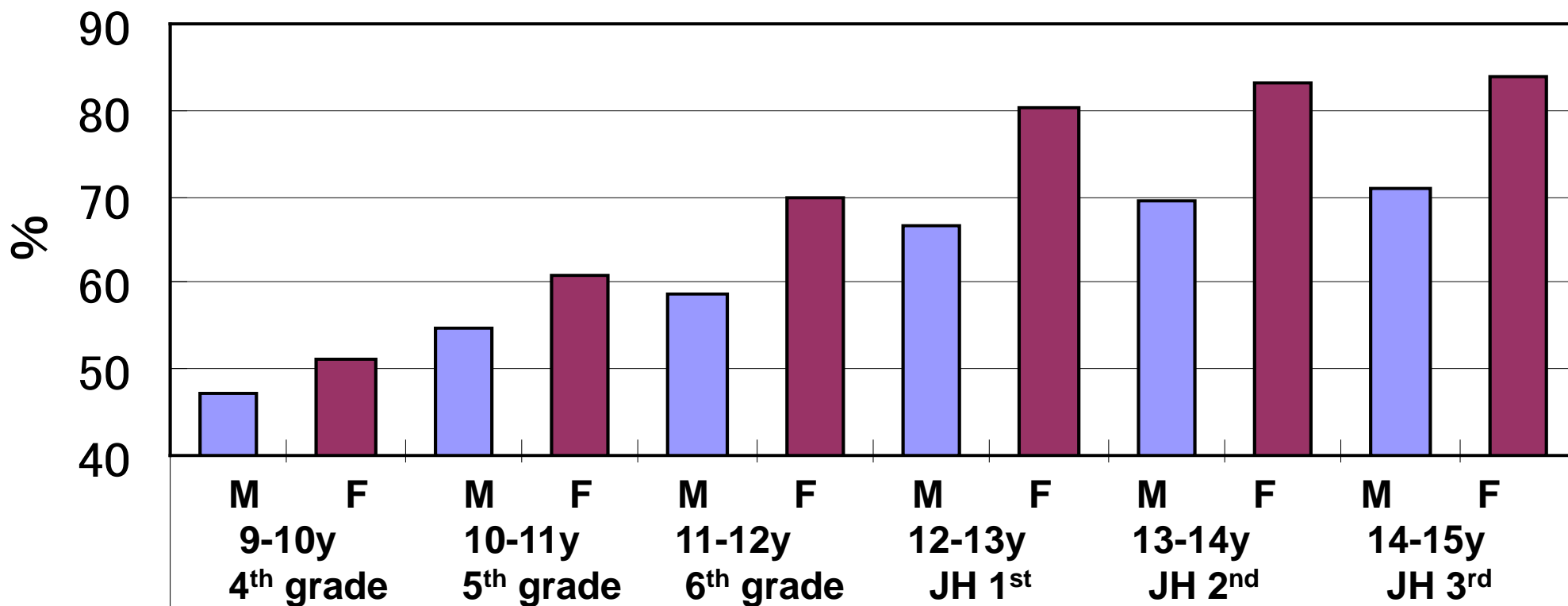
- December 4<sup>th</sup> 15:30 - 17:00, 2010

**Congress of the International Pediatric Sleep  
Association *joint meeting with Pediatric Sleep  
Medicine Conference*, Rome 3-5, December 2010**



# Background 1/3

The rate of children who answered as always or sometimes to the following question;  
Are you getting sleepy during 3<sup>rd</sup> and 4<sup>th</sup> lessons?

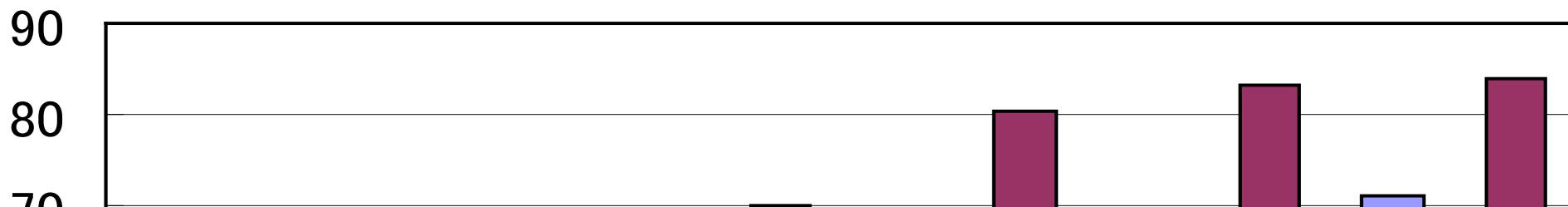


2005 by health care teachers in Tokyo



# Background 1/3

The rate of children who answered as always or sometimes to the following question; Are you getting sleepy during 3<sup>rd</sup> and 4<sup>th</sup> lessons?



**More than 70% of junior high school students complained of daytime sleepiness.**

9-10y  
4<sup>th</sup> grade

10-11y  
5<sup>th</sup> grade

11-12y  
6<sup>th</sup> grade

12-13y  
JH 1<sup>st</sup>

13-14y  
JH 2<sup>nd</sup>

14-15y  
JH 3<sup>rd</sup>

2005 by health care teachers in Tokyo

# Background 2/3

## Insomnia Among Japanese Adolescents: A Nationwide Representative Survey

Yoshitaka Kaneita, MD<sup>1</sup>; Takashi Ohida, MD<sup>1</sup>; Yoneatsu Osaki, MD<sup>2</sup>; Takeo Tanihata, MD<sup>3</sup>; Masumi Minowa, MD<sup>4</sup>; Kenji Suzuki, MD<sup>5</sup>; Kiyoshi Wada, MD<sup>6</sup>; Hideyuki Kanda, MD<sup>7</sup>; Kenji Hayashi, MD<sup>8</sup>

<sup>1</sup>Department of Public Health, School of Medicine, Nihon University, Tokyo, Japan; <sup>2</sup>Division of Environmental and Preventive Medicine, Department of Social Medicine, Faculty of Medicine, Tottori University, Yonago, Japan; <sup>3</sup>Department of Epidemiology, National Institute of Public Health, Wako, Japan; <sup>4</sup>Faculty of Humanities, Seitoku University, Matsudo, Japan; <sup>5</sup>Section on Behavioral Science, Division of Clinical Research, National Hospital Organization Kurihama Alcoholism Center, Yokosuka, Japan; <sup>6</sup>Department of Drug Dependence Research, National Institute of Mental Health, National Center of Neurology and Psychiatry, Kodaira, Japan; <sup>7</sup>Department of Hygiene and Preventive Medicine, Fukushima Medical University, Fukushima, Japan; <sup>8</sup>Vice President, National Institute of Public Health, Wako, Japan

**Study Objectives:** Although a number of previous studies have examined the prevalence of insomnia among adolescents, there have been very few nationwide studies. The objectives of this nationwide study were to clarify the prevalence of insomnia, its symptoms, and associated factors among Japanese adolescents.

**Design and Setting:** This study was designed as a cross-sectional sampling survey. The targets were junior and senior high schools throughout Japan. Sample schools were selected by cluster sampling. Self-reported anonymous questionnaires were sent to schools for all students to fill out.

**Participants:** A total of 103,650 adolescents responded, and 102,451 questionnaires were subjected to analysis.

**Intervention:** N/A

**Measurements and Results:** The prevalence of difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening was 14.8%, 11.3%, and 5.5%, respectively. Insomnia was defined as the presence

of one or more of these three symptoms. The prevalence of insomnia was 23.5%. Multivariate analyses revealed that, among junior high school students, male sex, poor mental health, skipping breakfast, drinking alcohol, smoking, not participating in extracurricular activities, and late bedtime had significantly higher odds ratios for insomnia. Among senior high school students, the same characteristics were associated with a significantly higher odds ratio for insomnia, as was the additional factor of having no intent to study at university.

**Conclusion:** Insomnia in Japanese adolescents is common and associated with multiple factors. The results of this study suggest the need for comprehensive program to prevent insomnia in Japanese adolescents.

**Keywords:** Insomnia; adolescents; Japan

**Citation:** Kaneita Y, Ohida T, Osaki Y et al. Insomnia among Japanese adolescents: a nationwide representative survey. *SLEEP* 2006;29(12):1543-1550.

# Background 2/3

## Insomnia Among Japanese Adolescents: A Nationwide Representative Survey

Yoshitaka  
Kanda,

<sup>1</sup>Department of  
Wako, Hospital  
Health,  
University,

The prevalence of insomnia in a total of 102,451 adolescents in Japan was 23.5% (difficulty in initiating sleep; 14.8%, difficulty in maintaining sleep; 11.3%, early morning awakening; 5.5%).

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**About one quarter of junior high and high school students suffer from insomnia.**

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## Background 3/3

More than half of students in Japan complained of daytime sleepiness, while about one quarter of junior high and high school students in Japan suffer from insomnia.



# Introduction 1/3

- According to the conventional diagnostic criteria, most of these youngsters might be diagnosed as having behavioral-induced insufficient sleep syndrome due to inadequate sleep hygiene.
- If this diagnosis is correct, they must be cured easily by following **adequate sleep hygiene (=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).





## Introduction 2/3

- According to the conventional diagnostic criteria, most of these youngsters might be diagnosed as having behavioral-induced insufficient sleep syndrome due to inadequate sleep hygiene.
- If this diagnosis is correct, they must be cured easily by following sleep health.
- However, this therapeutic approaches often fail.
- No one knows the reason for this failure.



# Introduction 3/3

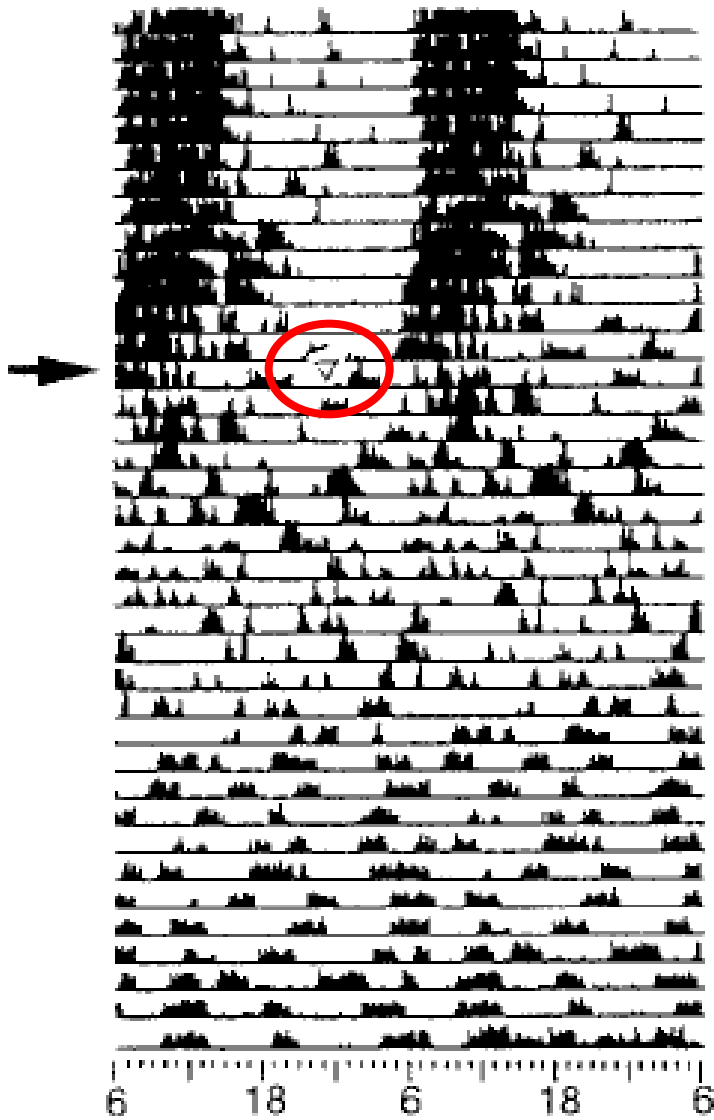
- To explain the reason for the failure to help youngsters in Japan by providing adequate sleep health, a new clinical entity - **asynchronization** - was proposed (Kohyama J (2009). Brain Dev 31, 255-273 ).
- This term has been designated with special reference to the concept of **singularity**.

# Syngularity

- Circadian singularity behavior (also called suppression of circadian rhythms) was discovered in 1970, according to observation that specific, dim, blue-light, pulse stimulus, with a unique stimulus time and duration, resulted in disturbed circadian rhythm in *Drosophila*
- [Winfree AT (1970). Integrated view of resetting a circadian clock. *J Theor Biol*, 28, 327-374].

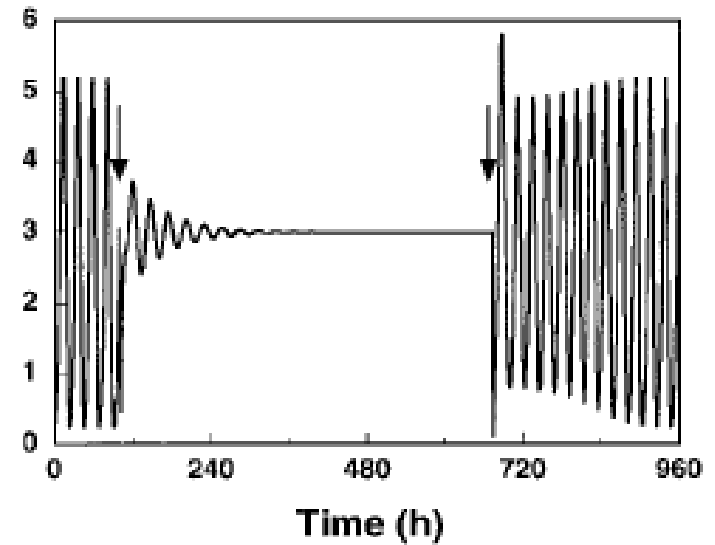
# Examples of syngularity

V70-929



Double-plotted locomotor activity of representative rhythm eradication produced by 1-h pulse at middle of subjective night.

Honma S, Honma K: *Light-induced uncoupling of multioscillatory circadian system in a diurnal rodent, Asian chipmunk. Am J Physiol* 276: 1390R-9, 1999.



Circadian rhythm of the transcription levels of *tim* gene in *Drosophila* assessed by the TIM protein level was both suppressed and restored by a single pulse.

Leloup J-C, Goldbeter A: *A molecular explanation for the long-term suppression of circadian rhythms by a single light pulse. Am J Physiol* 280: R1206-12, 2001

# Asynchronization 1/6

- Essence:

Disturbance of various aspects (eg., cycle, amplitude, phase, and interrelationship) of biological rhythms that indicate circadian oscillation.

- Presumable causes:

Light exposure during the night.

Lack of light exposure in the morning.

Decreased physical activities.

# Asynchronization 1/7

- Essence:

Disturbance of various aspects (eg., cycle, amplitude, phase, and interrelationship) of biological rhythms that indicate circadian oscillation.

- Presumable causes:

Light exposure during the night.

Lack of light exposure in the morning.

Decreased physical activities.

→ Presumable disturbance of the biological clock in addition to that of serotonergic, melatonergic, and wake- and sleep-promoting systems.

# Asynchronization 2/7

- Symptoms 1/2:

Disturbances related to the autonomic nervous system  
sleepiness, insomnia, gastrointestinal problems,  
disturbance of hormonal excretion,  
sympathetic nervous system predominance

Somatic disturbances

tiredness, fatigue, neck and/or back stiffness, headache,  
persistent yawn, desire for sleep, wish to lie down,  
inactivity, slow movements (meal), lumbago

# Asynchronization 3/7

- Symptoms 2/2:

Disturbances related to higher brain function.

disorientation, loss of sociality, loss of will or motivation, impaired alertness and performance, difficulties to remember, difficulties to concentrate

Neurological disturbances

attention deficit, aggression, impulsiveness, hyperactivity, irritated, hypersensitive

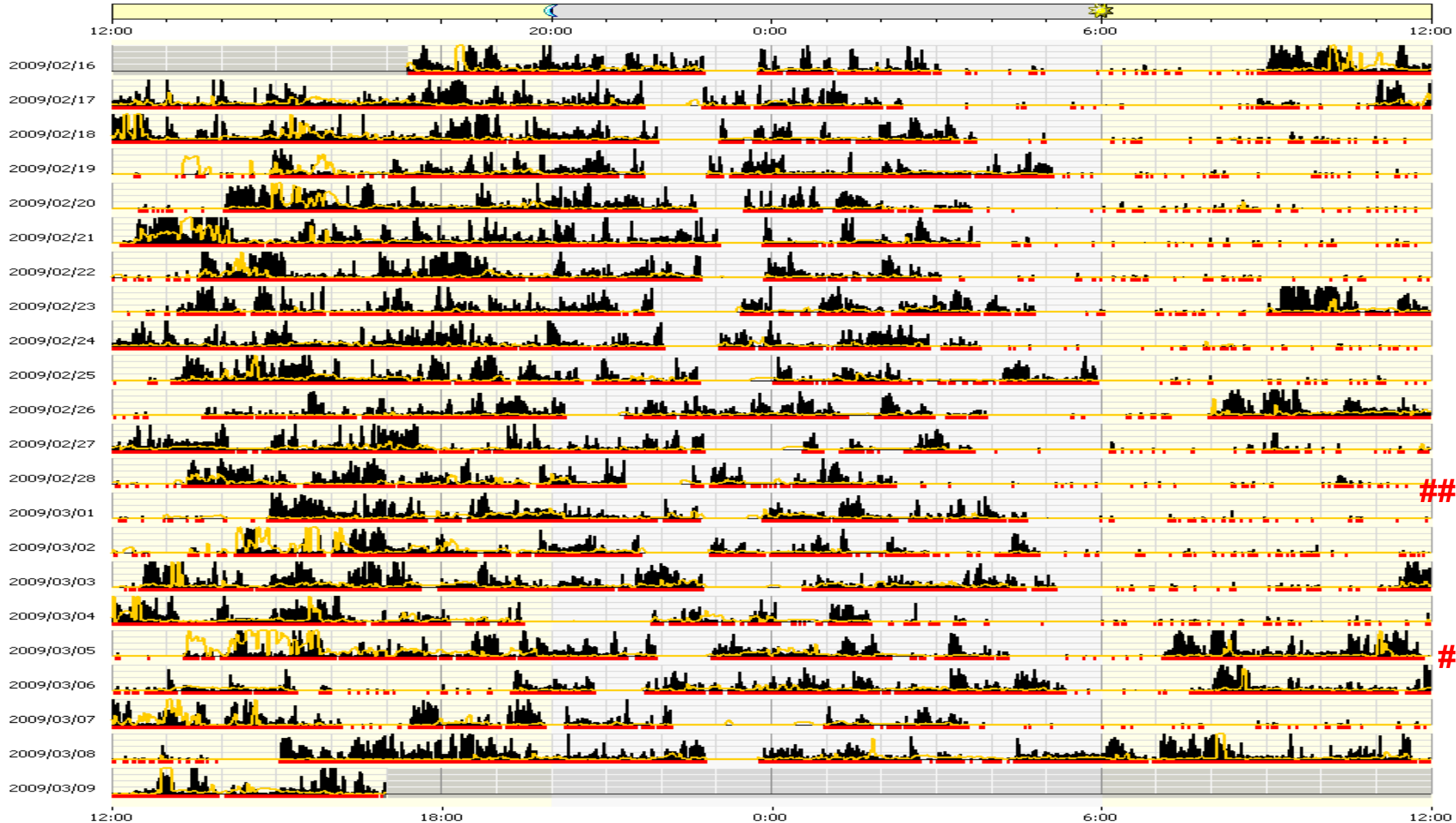
Psychiatric disturbances

Symptoms observed in depressive disorders, personality disorders and anxiety disorders.

Patients are inactive and are hard to hasten even the time to do something is approaching.



# S-W rhythm of a patient with asynchronization



**Sleep duration ranged 3.75(#)-11.00(##)hr (mean; 8.19)**

# Asynchronization 4/7

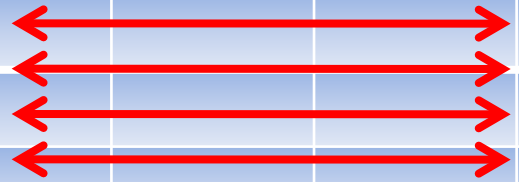
Differential diagnosis; Asynchronization and Circadian rhythm sleep disorders, delayed sleep phase types

- **Circadian rhythm sleep disorders,**  
**delayed and advanced sleep phase types**  
**sleep quality and duration are normal for age**  
**irregular sleep—wake type**  
**total sleep time per 24-hour period is essentially**  
**normal for age.**
- **Asynchronization**  
**sleep duration varies markedly day by day.**  
**(e.g.; 0-15 hours a day )**

ICSD-2, 2005

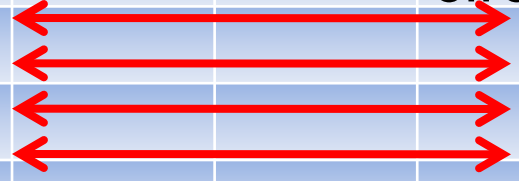
18 21 24 3 6 9 12 15 18

**Normal**



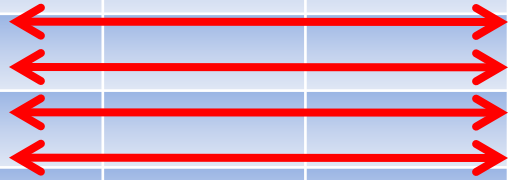
Schematic drawings of sleep pattern in circadian rhythm sleep disorders including asynchronization.

**Delayed**

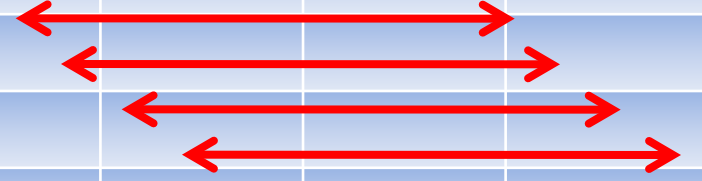


disorders including asynchronization.

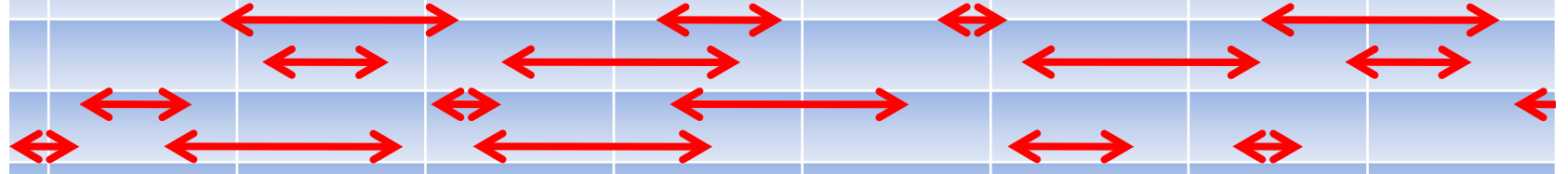
**Advanced**



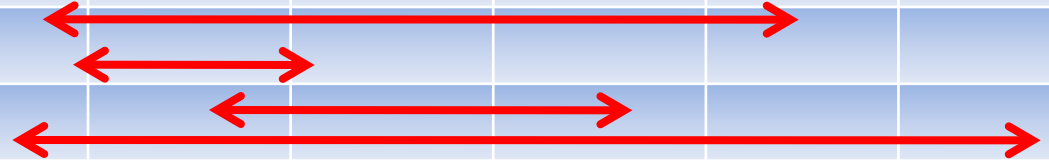
**Free-running**



**Irregular**



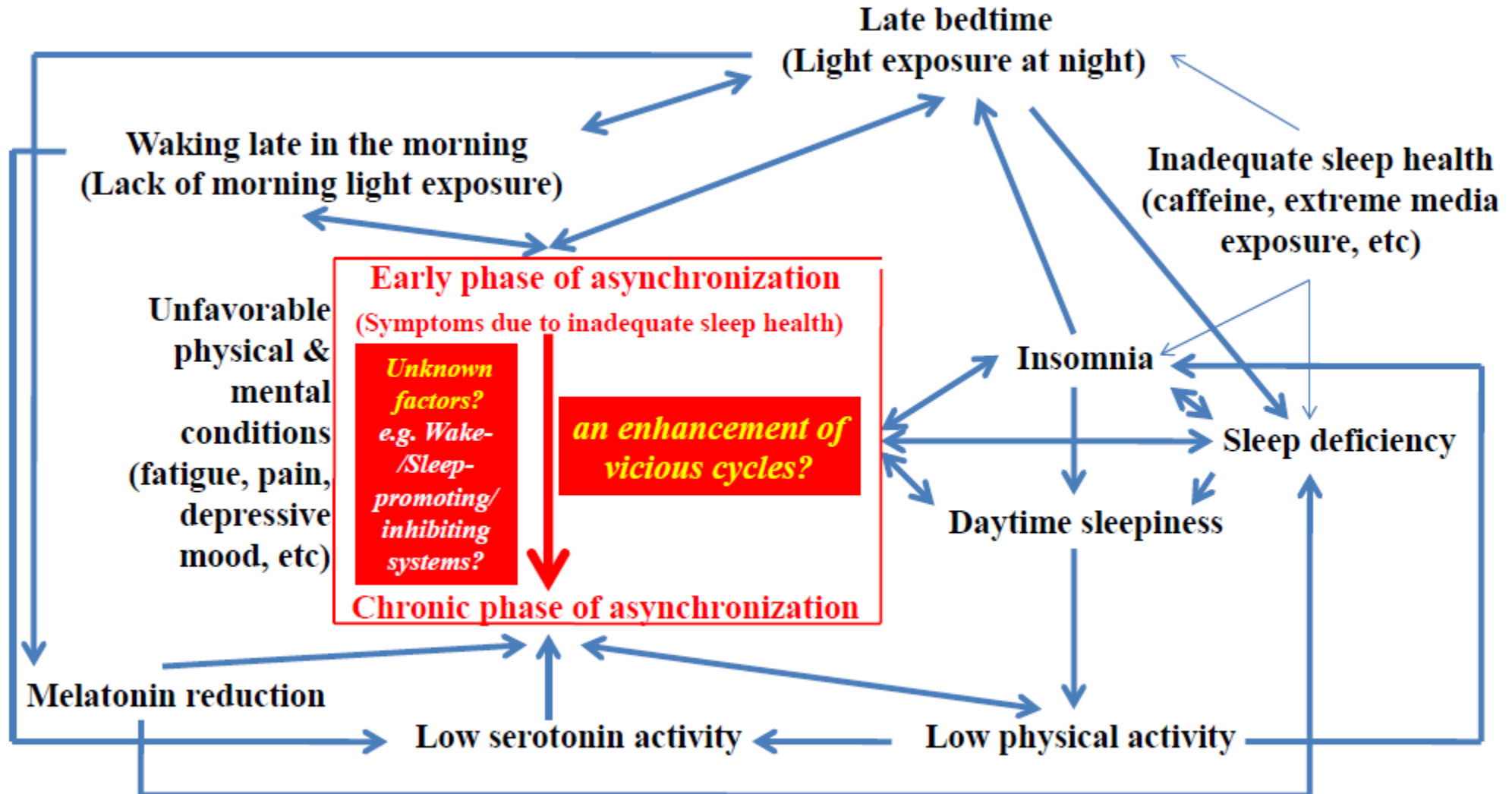
*Asynchronization*





# Asynchronization 5/7

## Schematic drawing of the development of asynchronization



# Asynchronization 6/7

- Presumable prognosis:

Early phase:

Disturbances are functional and can be relatively easily resolved, eg., through establishment of a regular sleep-wake cycle.

Chronic phase:

Without adequate intervention, disturbances can gradually worsen, involving loss of serotonergic activity, which is difficult to resolve.

# Asynchronization 7/7

- Potential therapeutic approaches:

Morning light exposure, an avoidance of nocturnal light exposure, conventional approaches

light therapy, medications (hypnotics, antidepressants, melatonin, vitamin B12),

physical activation, chronotherapy

and alternative ones.

Kampo, respiration (qigong, tanden breathing),

control of the autonomic nervous system, etc

# A proposed diagnostic criteria of asynchronization.

**Patients are suffering from both insomnia and hypersomnia.**

**Patients also showed disturbances related to the autonomic nervous system including sympathetic nervous system predominance, somatic disturbances, disturbances related to higher brain function, neurological disturbances, and also psychiatric disturbances.**

**Most patients are inactive and are hard to hasten.**

**Sleep duration varies markedly day by day.**



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## Take home message

To prevent adolescents from falling into asynchronization, tell them sleep health.





# Sleep health; basic four principles

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