

Effects of Reading a Picture Leaflet on Rhythm for Enhancement of Morning-Typed Life in Japanese Infants

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Abstract

In this study, a teaching material as a picture leaflet for infant was made, and the educational effectiveness of the leaflet was examined on the infants who attend one of ten nursery schools or a Kindergarten affiliated to Faculty of Education, Kochi University. The title of the picture leaflet is “A picture book on diurnal rhythm! Let’s take cow milk breakfast and become a morning-typed person!” (Seikatsu-rizumunohon, gyunyudehayanehayaoki: in Japanese). An intervention study was performed using an integrated questionnaire. The questionnaire before the intervention was administered and parents of 820 infants (711 ones attending one of the 10 nursery schools and 109 ones attending the Kindergarten) answered the questionnaire instead. All parents were asked to read the picture leaflet to their children every day during three weeks intervention period of June, 2016. Ratio of infants who had the reading of the leaflet more than 1 time for the 3 weeks was 94.5% and the average days when the reading of it was performed was 10.8 days. More than half of parents (52.4%) performed the reading it more than 10 days. Eleven percent (18 parents) of parents performed the reading every day of 21 intervention-days. In the first week of intervention, about 60% (97 infants) of the parents performed the reading in more than 4 days. Infants who had the reading it from their parents everyday got up in earlier time significantly than those who did it not in every day (U-test, $z = -4.33$, $p < 0.01$). Infants who had the reading of it every day went to bed in earlier time than the other ones who did it not in every day (U-test, $z = -7.731$, $p < 0.001$), and they slept more hours than the other ones (U-test, $z = -2.30$, $p < 0.001$). In conclusion, the reading of a picture leaflet which recommends a morning-typed life seems to be effective for

infants to promote the morning-typed life and quality of life (QOL) even though the intervention period is short as three weeks.

Keywords

A Picture Leaflet as a Teaching Material, Small Children Aged 2 - 6 Years Old, Morningness-Eveningness, Intervention Study, Protein Resources at Breakfast

1. Introduction

This study tries to clarify whether a new leaflet ([Appendix 1](#) and [Appendix 2](#)) for infants, which was newly evaluated for small Japanese children. Before the methodology and results in this study will be described, it is introduced how the researchers have been performed on the breakfast and mental health (1-1), body mass (1-2), school bullying (1-3), academic achievements (1-4), total health (1-5), breakfast-education and breakfast-supplying program (1-6), breakfast-skipping problem (1-7) and evaluation of a teaching material for breakfast (1-8), for children so far.

1.1. Breakfast and Mental Health in Children

Breakfast seems to be very important for promoting children's mental health. For example, better mental health can be promoted by the nutritionally rich breakfast (including protein resource as tryptophan supply: [Harada et al., 2007](#); [Nakade et al., 2009, 2012](#); [Harada et al., 2012](#); [Wada et al., 2013](#)) based on basic questionnaire studies and intervention studies. On the relationship between the mental health and the frequency to take breakfast in Korea, the data were obtained from the 2013 Korean Community Health Survey; a total of 207,710 survey participants aged 20 years or over were studied. Participants were categorized into three groups by the frequency of breakfast consumption as follows: "seldom," "sometimes," and "always." ([Lee et al., 2017](#)). Participants who had breakfast seldom or sometimes had higher depressive symptoms than those who always ate breakfast. In an interview report for elementary school students, the omission rate, intrusion rate, and inflation ratio were greater in the case of breakfast skipping than for lunch skipping ([Baxter et al., 2007](#)).

1.2. Breakfast and Obesity or Body Mass Index (BMI)

The effect of breakfast and breakfast omission on daily food intake in normal and overweight participants was investigated ([Reeves et al., 2014](#)). All groups consumed significantly less energy, carbohydrate and fibre in the no breakfast week; however, overweight participants increased their sugar intakes. The findings highlight that the timing of food intake and habitual breakfast eating behavior are important factors when investigating why breakfast consumption may be associated with BMI. [Nakade et al. \(2015\)](#) showed that there was negative correlation between the diurnal type scores (lower scores mean evening-type) and body

mass index in mothers of Japanese infants.

Also in Japan, the objective of the present study was to evaluate the acute effects of skipping breakfast (SB) on energy intake and physical activity under free-living conditions. The present study used a randomized, crossover trial design comparing eating breakfast (EB). Skipping breakfast reduced energy intake during the day and morning physical activity in healthy women who were habitual breakfast eaters. The decreased energy expenditure related to physical activity after SB did not exceed the decreased energy intake which may lead to higher BMI (Yoshimura et al., 2017).

Another USA breakfast supplying program as the break FAST study successfully recruited 16 rural high schools and exceeded enrolling and measuring a cohort of students at baseline, including 30% minority students, into a randomized clinical trial. At the conclusion of the break FAST study, an intervention was effective in changing behavior and nutrition outcomes (nutritional quality of diet, BMI, and percent body fat) among students (Nanney et al., 2016).

1.3. Breakfast Which May Be Related to Cyberbullying and School Bullying

Self-reported data about Canadian children's experiences (11 - 20 years old) showed that 26.3% and 24.1% reported often (usually eat breakfast three times or more per week) and frequent (usually eat breakfast twice a week or less) breakfast skipping behavior, respectively (Sampasa-Kanyinga et al., 2014). Victims of both cyberbullying and school bullying presented greater likelihood of often (adjusted relative risk ratio (RR) = 1.55; 95% confidence interval (CI) = 1.17 - 2.06) and frequent (RR = 1.97; 95% CI = 1.28 - 3.03) breakfast skipping.

1.4. Breakfast and Academic Achievement in Schools

In Korea, a cross-sectional data on a sample of 1652 high-school seniors (942 males and 710 females) drawn from the 2004 Korea Education Employment Panel were analyzed. Females who skipped breakfast had a lower probability of having the highest scores in language (OR Z 0.41, $p < 0.05$), mathematics (OR Z 0.24, $p < 0.01$), or foreign language (OR Z 0.18, $p < 0.01$), while males had a lower probability of having the highest scores in language only (OR Z 0.46, $p < 0.05$) (Kang and Park, 2016). A cross-sectional study consisted of a sample of 1269 children (697 boys and 572 girls) aged 6 years from the Chinese city of Jintan. Findings showed that children who regularly have breakfast on a near-daily basis had significantly higher full scale, verbal, and performance IQ test scores (all $p < 0.001$) compared to children who "sometimes" have breakfast (Liu et al., 2013). Recently in Japan, elementary school children who had sleep hours generally longer than 9 hours showed clearly higher markings in Japanese language than those who had slept only less than 9 hours (Takeuchi et al., 2017).

1.5. Breakfast and Total Health of Children

As a role of breakfast in health in USA, definition and criteria for a quality

breakfast was shown by O'Neil et al. (2014). According to the "Research Commentary" of this reference, there have been evidences that consumption of a breakfast meal was positively associated with general health and well being for both adults and children, suggesting the need to elevate the importance of breakfast in dietary guidance and nutrition education and communications.

1.6. Breakfast Supplying Program in School and On-Line Breakfast Education

Supplying breakfast seems to be an effective method for children to have breakfast with full nutrition certainly. Several examples have been performed so far as follows. As an breakfast supplying program in South Africa, an evaluation included a three-phase approach to establish a baseline of learners in relation to performance and nutritional status; an interim phase; and final phase to ascertain any changes after the introduction of the breakfast programme. Triangulation of the anthropometric and qualitative research suggests that children benefitted from the public-private social investment scheme (Hochfield et al., 2016). In USA, a School Breakfast Program (SBP) was performed for cognitive achievement (Frisvold, 2015). The SBP is a federal entitlement program that offers breakfast to any student, including free breakfast for any low-income student, who attends a school that participates in the program. Using the details of these mandates as a source of identifying variation, it was found that the availability of the program increased student cognitive achievement. Online education program was performed and it was effective in comparison with in-person education for increased frequency to take breakfast for children to examine the influences of online and in-person group nutrition education on changes in knowledge, attitudes, and behaviors related to breakfast eating (Au et al., 2016). Increases in the frequency of eating breakfast were greater for both the parents ($p = 0.0007$) and child ($p = 0.01$) in the online group education group compared with the in-person group education during the same time points.

1.7. Factors to Be Related to the Breakfast Skipping in Children

For promoting taking nutritionally rich breakfast for children, attitudes, parental descriptive norms and clustering at school level are reported to be important and also related to breakfast skipping (Moore et al., 2009). In this study, participants were 1672 year 5 and 6 pupils within 52 schools in 9 local education authorities across North, South and West Wales. In multivariate ordinal logistic regression analyses, adjusted for clustering at the school-level, only attitudes towards breakfast, parental descriptive norms and self-efficacy for eating breakfast were significantly associated with breakfast skipping (Moore et al., 2009).

1.8. A Teaching Material of a Picture Book for Young Children

Tryptophan included in proteins taken at breakfast seems to become resource for morning synthesise of serotonin in the morning based on the resent research (Harada et al., 2007). Serotonin can be affective for promoting mental health and

also can be an inner zeitgeber for circadian clocks of human (Nakade et al., 2009). The serotonin can be synthesized into melatonin at night in pineal which promotes fall-in-sleep at night. Protein which was consumed at breakfast could be effective for promoting the mental health through another synthesis from thyroxin and phenylalanine into dopamine in Japanese infants (Akimitsu et al., 2013). Consumption of cow milk at morning can promote the shifting of the diurnal rhythms of infants and university athletes and promote their sleep health (Takeuchi et al., 2014; Harada et al., 2015; Kawada et al., 2016 a, b).

The significance of the research from practical social significance is that a new teaching material as “picture book” and academic significance, these two aspects are important for research significance.

A direct teaching material like as a picture leaflet for promoting “morning-typed life and taking nutritionally rich breakfast” might be effective for especially small children attending kindergarten and elementary schools. However, there have been no such teaching materials for small children so far. However, direct and familiar teaching subjects for promoting the health of infants through morning consumption of cows’ milk and following morning-typed life style have not been evaluated yet. In this study, a teaching material as a picture leaflet for infant was made, and the educational effectiveness of the leaflet was examined on the infants who attend ten nursery schools and a Kindergarten affiliated to Faculty of Education, Kochi University. The title of the picture leaflet is “A picture book on diurnal rhythm! Let’s take cows’ milk at breakfast and become a morning-typed person!” (Seikatsu-rizumunoe hon, gyunyudehayane hayaoki: in Japanese).

2. Methods

2.1. Participants and Instruments

A picture leaflet was newly made entitled “A picture book on diurnal rhythm! Let’s take cows’ milk in the morning and become morning-typed persons!” (Appendix 1 and Appendix 2).

An intervention study was performed using an integrated questionnaire. The questionnaire (Harada et al., 1998; Takeuchi et al., 2014, 2015) before the intervention was administered and parents of 820 infants (Table 1) (711 ones attending one of 10 nursery schools and 109 ones attending a Kindergarten affiliated to Faculty of Education, Kochi University) answered the questionnaire instead. The questionnaire included questions on sleep habits, mental conditions (anger, irritation, out-of-control of emotion, depression), the Diurnal Type Scale (DTS) (Torsvall & Åkerstedt, 1980), meal habits, and light environments (Harada et al., 1998). All parents who were asked to read the picture leaflet everyday during three weeks intervention period of June, 2016. A questionnaire on breakfast contents and sleep onset and offset which was shown by Table 2 was administered to the parents during the intervention 3 weeks. Only 20% of the participants attending in 10 nursery schools and one kindergarten filled with the

Table 1. The number of participants for questionnaire study before intervention and the following intervention.

	Distribution	Answer	Rate to answer	Number for analysis	Answer rate for analysis
Nursery schools	711	152	21.38	108	15.19
Kindergarten	109	74	67.89	56	51.38
In total	820	226	27.56	164	20

Table 2. A questionnaire during the intervention period of 3 weeks.**Sheet for checking several habits during the intervention**

Please write down wake up time and go to bed time every day. On the breakfast your child (children) took, you can write every day whether the three components of carbohydrates, main dish (protein resource) and cows' milk. You can write down every day whether you performed the reading of the picture book distributed.

○: Yes; ×: No,

	June 16	17	18	19	20	21	22	23	24	25	26
Wake up time											
Carbohydrate											
Breakfast Main dish											
Cow milk											
Reading performance											
Bed-in-time											
	June 27	28	29	30	July 1	2	3	4	5	Number of ○ in total	
Wake up time											
Carbohydrate											
Breakfast Main dish											
Cow milk											
Reading performance											
Bed-in-time											

Example of foods

1. **Carbohydrate:** bread, boiled rice, noodle, serial etc

2. **Main dish:** fishes, meats, soy beans, fermented beans and tofu, ham and sausage etc.

3. **Cow milk and milk products:** cow milk, cheese and yogurt etc.

Please check the sheet, which can be put on your refrigerator for 3 weeks from 14th June to 4th July 2017

We can collect the sheet which has been filled with you, on 10th July 2017 which will be dead line for sub-mission.

questionnaire through the 3 intervention periods. The questionnaire as a life habit diary consists of bedtime, wake up time, breakfast contents, whether the reading of the picture leaflet was performed in each of the intervention 3 weeks. The question on breakfast contents was whether infants take nutritionally good breakfast including the three items: carbohydrates, protein, and cows' milk (Table 2).

2.2. Statistic Analysis

The questionnaire data was analyzed with SPSS 12.0 statistical software. The categorized data in the diary data were analyzed using Fisher's exact probability test. Mann-Whitney U-test (data in order—categorized data) and χ^2 -test (categorized data-categorized data) were used for non paired data in this study.

2.3. Ethic Treatment

The study followed the guidelines established by the *Chronobiology International* journal for the conduct of research on human subjects (Portaluppi et al., 2010). Before administrating the questionnaires for this intervention study, each participant (parents or guardians) was given a written explanation that detailed the concepts and purposes of the study and stated that their answers would be used only for academic purposes. After the above explanation, all parents (or guardians) agreed completely with the proposal. The study was also permitted by the kindergarten nurses' committees of the ten nursery schools and one kindergarten which carried out an ethical inspection of the contents of the questionnaire. As the young children could not complete the questionnaires themselves, their parents or guardians completed them on their behalf.

3. Results

Sleep habits in October, 2017, 3 months after the intervention were quite similar to those in June, 2017 just before the intervention with no significant differences ($p > 0.05$). Average of the DTSs before and after the intervention were 20.8 and 20.7, respectively, which are similar values without no significant differences.

Sixty and zero-point-seven percent of the parents (152 of the nursery schools and 74 of the kindergarten answered it) to whom the questionnaire was distributed, answered the question as the diary through the intervention 3 weeks. Twenty seven and zero-point-six percent (226/820) of the parents in which their infants attended one of 10 nursery schools and the Kindergarten answered the questionnaire consisting several questions during the intervention 3 weeks. On the intervention study, 164 answers which complete ones were used for analysis (Table 2). Forty seven percent of mothers read this picture leaflet to their children for 4 - 7 days per one week during the 3 weeks intervention period (Table 3). Only 20% of the participants attending in 10 nursery schools and one kindergarten filled with the questionnaire through the 3 intervention periods. The data of the 20% can be thought to show the data by the parents who kept relatively higher consciousness on their own children and their education. This point might be a limitation of this study. In the near future, another strategy should be evaluated for collecting data also from the parents who have lower consciousness on the education of their children.

Ratio of infants who had the reading of the leaflet more than 1 time for the 3 weeks was 94.5% and the average days when the reading of it was performed was 10.8 days. More than half of parents (52.4%) performed the reading it more than

Table 3. How many number (%) of participants were interpreted as read by parents of the leaflet in each of three weeks intervention period.

Intervention days	week 1	week 2	week 3
No interpretation days	13 (7.93)	29 (17.68)	27 (16.46)
1 - 3 days	54 (32.93)	57 (34.76)	60 (36.59)
4 - 7 days	97 (59.15)	78 (47.56)	77 (46.95)

10 days. Eleven percent (18 parents) of parents performed the reading every day of 21 intervention-days (**Figure 1**). In the first week of intervention, about 60% (97 infants) of the parents performed the reading in more than 4 days (**Table 3**).

Infants who had the reading it from their parents everyday got up in earlier time significantly than those who did it not in every day (U-test, $z = -4.33$, $p < 0.01$) (**Figure 2**). Infants who had the reading it went to bed in earlier time than the other ones who did it not in every day (U-test, $z = -7.731$, $p < 0.001$) (**Figure 3**), and they slept more hours than the other ones (U-test, $z = -2.30$, $p < 0.001$) (**Figure 4**). Infants who had the reading it from their parents every day got main dish (protein resource) in more days (Fisher's exact test, $p = 0.021$) and took cows' milk at breakfast in more days (Fisher's exact test, $p < 0.001$) than the other ones.

Wake up time (U-test, $z = -3.30$, $p = 0.001$) (**Figure 5**) and bed-in time (U-test, $z = -3.94$, $p < 0.001$) (**Figure 6**) in the next day of the day when the reading of the picture leaflet was performed were earlier than those in the days next to the days when the reading was not performed. Sleep hours (U-test, $z = -2.25$, $p = 0.024$) (**Figure 7**) were significantly longer in the next days of the days when the picture leaflet was read, than the other days. The frequencies to take main dish (protein resource) (Fisher's exact test, $p < 0.001$) (**Figure 8(a)**) and cows' milk (Fisher's exact test, $p < 0.001$) (**Figure 8(b)**) were higher in the next days of the days when the reading it was performed than those in the other days.

4. Discussion

About 50% of the parents (mainly mothers) implemented the reading of the picture leaflet to their children on the 12 - 21 days during the 21 days intervention period. Reading the picture leaflet may prohibit the children to get up later than 7:30 and also may prohibit them to go to bed later than 21:00. As the result, this leaflet can make the children to have sleep hours longer than 10. 5 hours from this result. Together with the daytime sleep about 2 hours in the nursery schools, the total sleeping hours could be elongated up to more than 12.5 hours after the effects of reading this picture leaflet in this study. On average, the

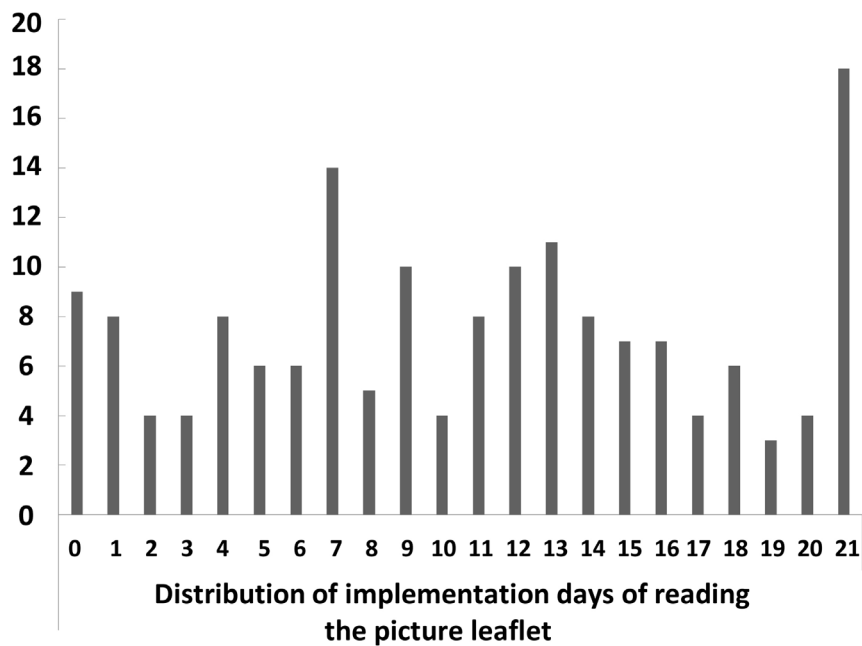


Figure 1. Implementation days of reading the picture leaflet on diurnal rhythm.

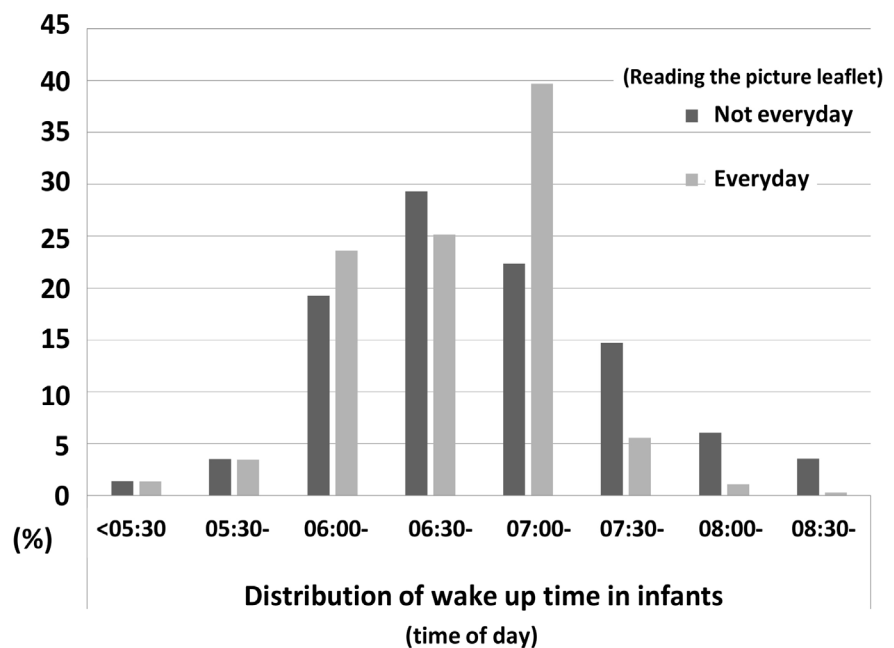


Figure 2. Comparison of wake up time of the children who had reading of the leaflet every day from their parents to the time of those who did it not all the days.

Japanese infants aged 2 - 6 years currently showed 11:00-11:30 as the total sleeping hours including naps in the daytime. In Spanish infants aged 2 - 5 years, the average value of the total sleeping hours including naps were 10.67 hours on 1987 and 10.27 hours on 2011 (de Ruiter et al., 2016). The reading of this picture leaflet may be effective for making children have longer sleep hours by 1 - 2 hours.

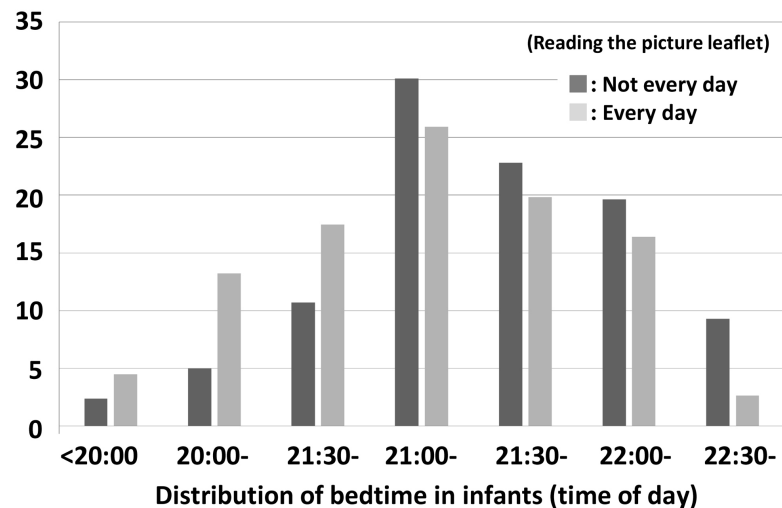


Figure 3. Comparison of bed time of the children who had reading of the leaflet every day from their parents to the time of those who did it not all the days.

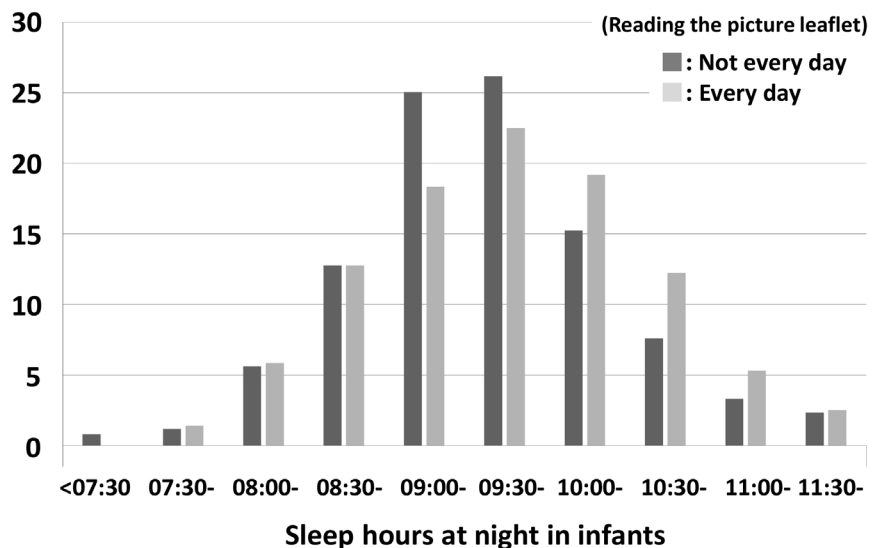


Figure 4. Comparison of the night sleep hours of the children who had reading of the leaflet every day from their parents to the time of those who did it not all the days.

In the next days of the days when the reading of the picture leaflet, the number of infants whose the wake up times later than 7:30 were apparently decreased, while the bed times after the reading days slightly shifted to earlier times. Such reading of the leaflet may be in some extent effective for children to be shifted to more morning-typed persons. However, longer intervention during a half year or one year may be more effective for promoting their morning-typed life. In the near future, the intervention study for the longer period is remained to do.

There have been no significant differences in sleep habits and the diurnal type scale scores in Japanese infants between June before intervention and October 3 months after that in 2017. Due to the seasonal change, October has shorter photoperiod than June. Because of later sun-rise, infants in October should be more

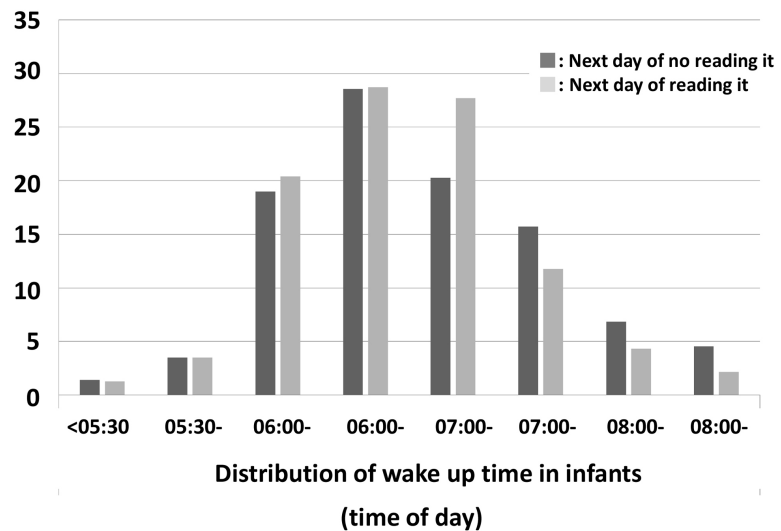


Figure 5. Comparison of wake up time in the days next to days when children had the reading of the leaflet from their parents to that in the days next to days when children did not.

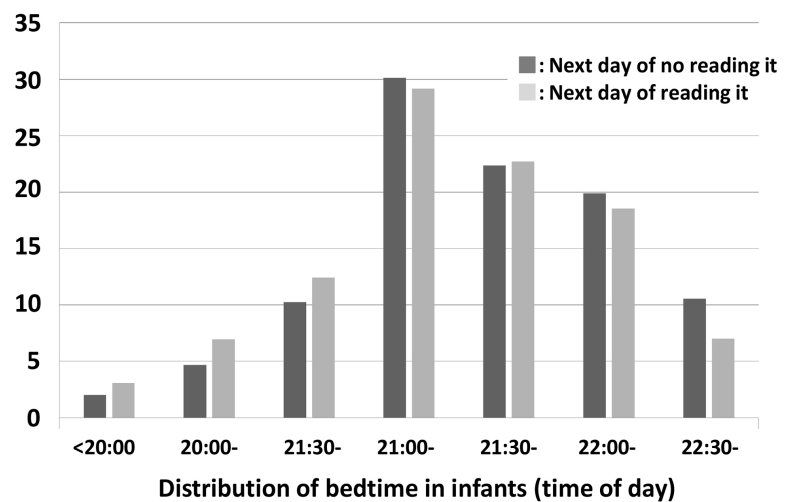


Figure 6. Comparison of bed time in the days next to days when children had the reading of the leaflet from their parents to that in the days next to days when children did not.

evening-typed and worse sleep habits than those in June at 33°N in Kochi. The similar sleep habits and diurnal types in June and October would show that the intervention by the new picture leaflet had some effects of shifting infants to the direction of “morning-type”.

As the limitation of this study, only subjective data were available for evaluation of the effects of this new teaching material as picture leaflet. In the future, direct data using actigraph and consumption of saliva would be possible even from small children for such evaluations if there would be full understanding, by parents of small children, of the purposes of this study (promotion of health of children) and of impacts for future education.

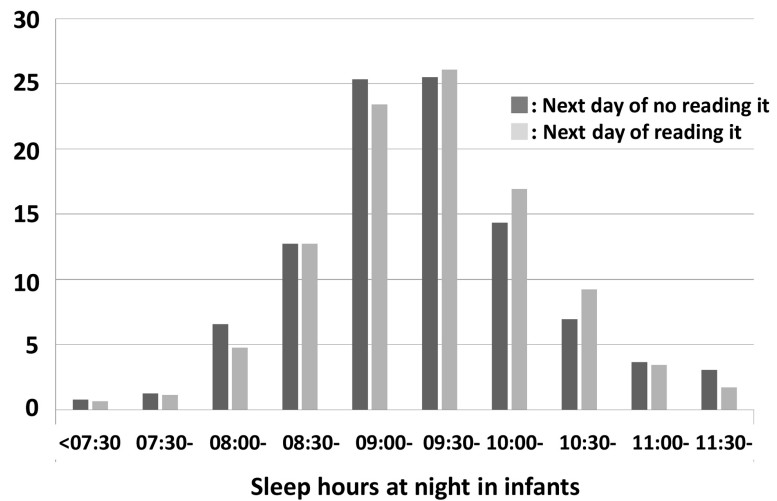


Figure 7. Comparison of sleep hours in the days next to days when children had the reading of the leaflet from their parents to that in the days next to days when children did not.

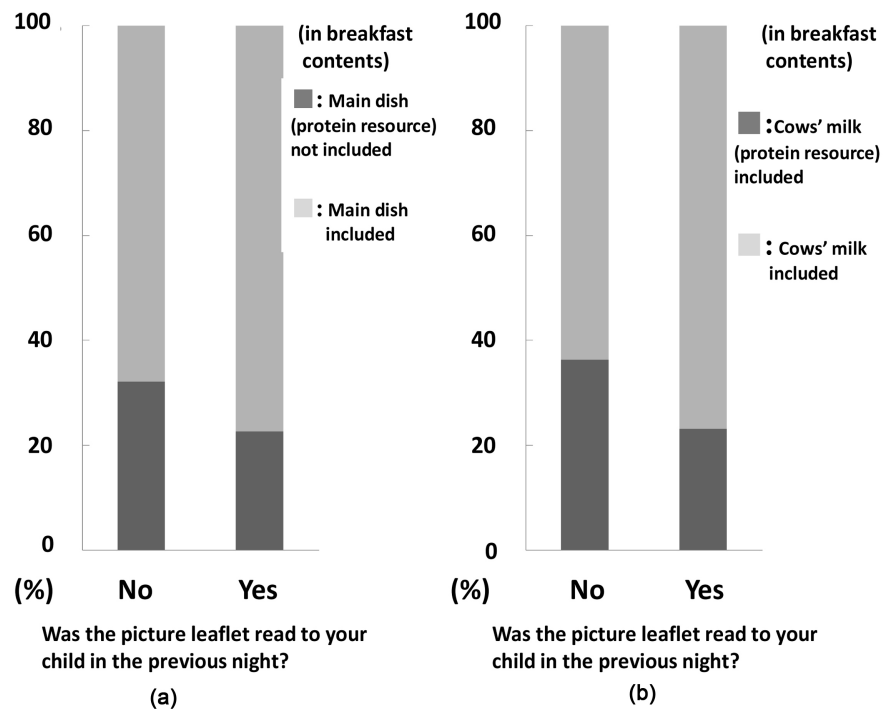


Figure 8. (a): Comparison of the rate of students who took main dish (protein resource) at breakfast in the days next to days when children had the reading of the leaflet from their parents to that in the days next to days when children did not. (b): Comparison of the rate of students who took cow milk at breakfast in the days next to days when children had the reading of the leaflet from their parents to that in the days next to days when children did not.

5. Conclusion

In conclusion, the picture leaflet seems to have a powerful intervention effect for promoting Japanese infants' "morning-typed life" based on the results of this

study. The style of “picture book” might become teaching materials psychologically near not only to infants but to elementary and junior high schools students. The picture leaflets include detailed comparisons between morning-typed life and evening-typed life and children can easily image the detailed life styles, which should be recommended. The intervention studies also for the elementary school and junior high school students will go on using the picture leaflets for elder children in the near future.

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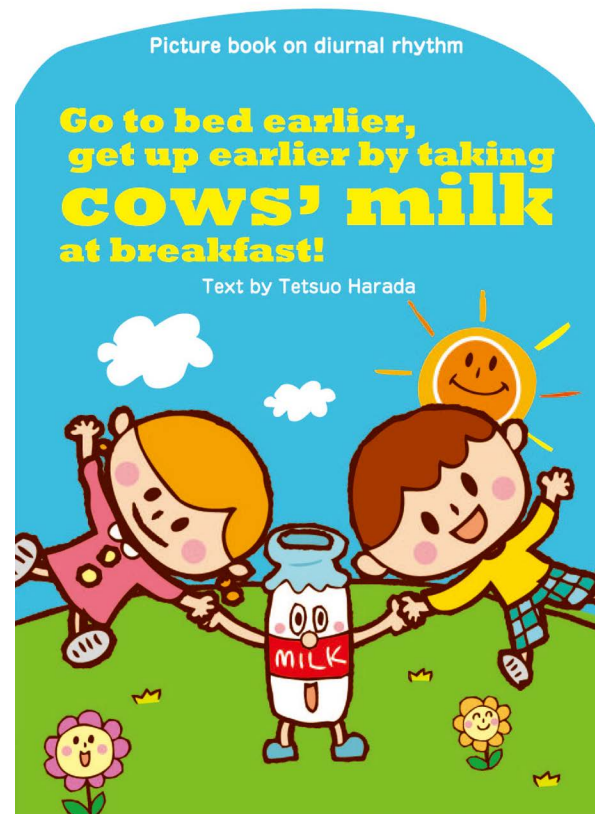
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Appendix 1



(One day of "morning-typed" infant)
A morning-typed infant gets up early in the morning.
He (or She) switches on the fluorescent lamp in his (or her) room and
open the curtain.¹⁾

Let's take breakfast
which consists of
boiled rice, soybean soup with "Tofu",²⁾
fried eggs, fermented soy beans
called "Natto"²⁾ and vegetables.
And he (or she) takes cows' milk at breakfast.
(However, infants with milk allergy do not
need to take cows' milk.). If he (she) finished
taking breakfast, let's change clothes and leave home for school!

(One day of "evening-typed" infant)
An evening-typed infant is not well being
in the morning, and he (or she) is not well
consciousness after getting up.
He (or she) takes long time after getting up till
being back to ordinary alertness.

Let's take breakfast! However,
the evening-typed infant does not have appetite,
because he (or she) stayed in the bed late
in the morning.
He (or she) can take one piece of bread and
a sweet beverage, only.²⁾ He (or she) does not take
cows' milk and has to change clothes quickly for
leaving home to go to school.

1) Let's be exposed to sun lights or lights from fluorescent lamp just after waking up.
In the summer season, please use a thin curtain for sun lights coming through it into the room. In the winter, please switch on all the lightings as fluorescent lamps
emitting white lights in the morning. Reasons (evidence): Core body temperatures in humans fluctuate having diurnal rhythms with peak at 15:00-18:00 and with
bottom at 04:00-05:00. The exposure to sun lights or white lights during 3 or 4 hours from the bottom time is known to make the phase of circadian clock
advance.

2) We can recommend cows' milk and fermented soy beans called Natto as breakfast menu. Because 98% of nutrition in Natto can be digested and absorbed into the
body, much amount of tryptophan as a precursor of serotonin can be taken into the body from only small amount of Natto. However, cows' milk is the best
recommendation, because it can be easily bought (cheap) and any kinds of shops we can get and taken. Let's drink cows' milk like as Japanese tea in the morning.
Our research on the infants living in Kochi city showed that the infants who took only cows' milk at the breakfast were more morning typed than those taking
carbohydrate only. Of course, bacon, dry beans and cooked fishes and so on are effective for the serotonin synthesis like as cows' milk and Natto. Anyway, please
add one dish (as protein resources) into breakfast menu. Most of foods as protein resources include much amount of Vitamin B₆, and are effective for serotonin
synthesis themselves. Vegetables and fruits are also effective for serotonin synthesis as Vitamin B₆ resources.

During moving from home to nursery school (or kindergarten), he (or she) is exposed to sun-lights. After arriving at the nursery school (or kindergarten), he (or she) is playing out side in the garden of the nursery school (or kindergarten).⁸³

The infants who are morning-typed are well-being and powerful physically and mentally.⁸³

After the nursery school (or kindergarten), one of family members pick him (or her) up and go to home.



In the evening, the morning-typed infant sits in the room where the lightings are emitting not "white" lights but "orange" ones till the bed time.⁸⁴

The morning-typed infant does neither watch TV and nor play game at evening and night.⁸⁵

During moving from home to nursery school (or kindergarten), he (or she) is sleeping in the car or bus.⁸³ After arriving at the nursery school (or kindergarten), he (or she) is resting in the room of nursery school (or kindergarten).⁸³

The infants who are evening-typed are neither well-being and nor powerful physically and mentally.⁸³ there in the nursery school (or kindergarten).

After the nursery school (or kindergarten), one of family members picks him (or her) up and go to home.



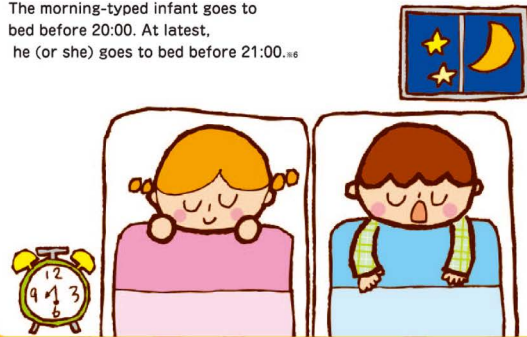
The evening-typed infant sits in the room where the lightings are fluorescent lights and emitting "white" lights till the bed time.⁸⁴

The evening-typed infant watches TV very much and plays game at evening and night, and go to bed late in the evening.⁸⁵

⁸³ Serotonin synthesis during daytime can make concentration of humans increased. Much knowledge has been accumulated from several researches on infants in Kyoto city and students attending soccer club in Kyoto University. When infants take protein (hydrophobic) resources like as haito and cow's milk and also resources of Vitamin B (coenzyme for serotonin synthesis), and after that when they are exposed to the sun-lights, much amount of serotonin can be synthesized in their brain (mainly from hydrophobic) in the morning. Due to this synthesis, infants can become more powerful mentally with high concentration. The melatonin can be synthesized at night from serotonin at the same part (pineal) of their brains. Melatonin can act as sleep onset substance at night at children's brains.

⁸⁴ Please use the lightings emitting orange-colored lights at night. Reasons (evidences): Melatonin can be fully synthesized and secreted into plasma without being suppressed by "white lights" and children can fall in sleep smoothly at night with sufficient plasma melatonin. Blue lights with wave length of about 460 nm (luminance peak for melatonin as a key receptor to control melatonin and circadian clock phase) which are included in the white lights emitted from fluorescent lamps, can suppress melatonin synthesis down into zero for elementary children and down into one third for junior high students (evidences). Lightings for daytime are recommended to be fluorescent lamps (white lights) like as "sun lights". Lightings for night are recommended to be lightings emitting orange lights (lights at five places at home or candle lights and "moon lights").

The morning-typed infant goes to bed before 20:00. At latest, he (or she) goes to bed before 21:00.⁸⁶



Again the next morning comes to him (or her). The morning-typed infant wakes up naturally without any equipment at 06:00. He (or she) is wellbeing and powerful physically and mentally in the morning.

The evening-typed infant goes to bed about 22:30. At latest, he (or she) goes to bed 23:00 or even later.⁸⁶



Again the next morning comes to him (or her). The evening-typed infant cannot wake up without some equipment at 06:00. He (or she) is neither wellbeing mentally and nor powerful physically in the morning.



⁸⁵ Please make the duration of watching TV and playing game for infants limited within 1 hour. The number of children to play game actively at night, increases from the middle grade of elementary school in Japan. When they watch TV and play game more than 1 hour per night, sleep health and mental health of infants and elementary school students were worse based on research evidences which showed that watching TV and playing game every day had negative effects on their health. Please make off-day for watching TV and playing game for infants. The blue lights emitted from TV displays can lead to suppress the melatonin synthesis and disturb the onset of sleep for infants. The TV watching at night should be avoided for small children.

⁸⁶ Timing for growth hormone synthesis and secretion into the body is critical. Timing of secretion of growth hormone can be about 20:00 - 21:00 for children and about 23:00 for adults (directly caused by body temperature decreases). If infants and adults awaken still in this time, the amount of growth hormone can be decreased. The growth hormone is known to be secreted at the timing of slow wave sleep (Stages 3 and 4) in Non-REM sleep. Therefore, being awakes at late time can lead to lower growth for children and lead not to be repaired of damaged tissues (related to beauty and aging) for adults.

Let's take cows' milk at breakfast!

When infants take cows' milk at breakfast and then are exposed to sun-lights, an amino acid "tryptophan-man" included in proteins of cows' milk can be changed to "serotonin-man" in their bodies.^{#2 #3}

The serotonin-man can be changed to "melatonin-man" at night in the body under the "orange-colored" lights in their bodies.^{#4}

The serotonin-man and the melatonin-man can make infants morning-typed persons!



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Appendix 2: English Text of the Picture Book Entitled "Going to Bed Earlier, Getting up Earlier by Taking Cows' Milk at Breakfast Which Is for Small Children (Infants)"

Picture book on diurnal rhythm

Title: Go to bed earlier, get up earlier by taking cows' milk at breakfast!

(Text by Tetsuo Harada)

One day of "morning-typed" infant)

A morning-typed infant gets up early in the morning. He (or She) switches on the fluorescent lamp in his (or her) room and open the curtain¹⁾. Let's take breakfast which consists of boiled rice, soybean soup with "Tofu"²⁾, fried eggs, fermented soy beans called "Natto"²⁾ and vegetables. And he (or she) takes cows' milk at breakfast. (However, infants with milk allergy do not need to take cows'

milk.). If he (she) finished taking breakfast, let's change clothes and leave home for school!

During moving from home to nursery school (or kindergarten), he (or she) is exposed to sun-lights. After arriving at the nursery school (or kindergarten), he (or she) is playing our side in the garden of the nursery school (or kindergarten)³⁾.

The infants who are morning-typed are well-being and powerful physically and mentally³⁾.

After the nursery school (or kindergarten), one of family members pick him (or her) up and go to home.

In the evening, the morning-typed infant sits in the room where the lightings are emitting not "white" lights but "orange" ones till the bed time⁴⁾.

The morning-typed infant does neither watch TV and nor play game at evening and night⁵⁾.

The morning-typed infant goes to bed before 20:00. At latest, he (or she) goes to bed before 21:00⁶⁾.

Again the next morning comes to him (or her). The morning-typed infant wakes up naturally without any equipment at 06:00. He (or she) is wellbeing and powerful physically and mentally in the morning.

(One day of "evening-typed" infant)

An evening-typed infant is not well being in the morning, and he (or she) is not well consciousness after getting up. He (or she) takes long time after getting up till being back to ordinary alertness.

Let's take breakfast! However, the evening-typed infant does not have appetite, because he (or she) stayed in the bed late in the morning. He (or she) can take one piece of bread and a sweet beverage, only²⁾. He (or she) does not take cows' milk and has to change clothes quickly for leaving home to go to school.

During moving from home to nursery school (or kindergarten), he (or she) is sleeping in the car or buse³⁾. After arriving at the nursery school (or kindergarten), he (or she) is resting in the room of nursery school (or kindergarten)³⁾.

The infants who are evening-typed are neither well-being and nor powerful physically and mentally³⁾ there in the nursery school (or kindergarten).

After the nursery school (or kindergarten), one of family members pickes him (or her) up and go to home.

The evening-typed infant sits in the room where the lightings are fluorescent lights and emitting "white" lights till the bed time⁴⁾.

The evening-typed infant watches TV very much and play game at evening and night, and go to bed late in the evening⁵⁾.

The morning-typed infant goes to bed about 22:30. At latest, he (or she) goes to bed 23:00 or even later⁶⁾.

Again the next morning comes to him (or her). The evening-typed infant cannot wake up without some equipment at 06:00. He (or she) is neither wellbeing mentally and nor powerful physically in the morning.

Let's take cows' milk at breakfast!

When infants take cows' milk at breakfast and then are exposed to sun-lights, an amino acid "tryptophan-man" included in proteins of cows' milk can be changed to "serotonin-man" in their bodies^{2),3)}.

The serotonin-man can be changed to "melatonin-man" at night in the body under the "orange-colored" lights in their bodies⁴⁾.

The serotonin-man and the melatonin-man can make infants morning-typed persons!

1) Let's be exposed to sun-lights or lights from fluorescent lamp just after waking up.

In the summer season, please use a thin curtain for sun lights coming through it into the room. In the winter, please switch on all the lightings as fluorescent lamps emitting white lights in the morning. Reasons (evidences): Core body temperatures in humans fluctuate with diurnal rhythms with peak at 15:00-16:00 and with bottom at 04:00-05:00. The exposure to sun-lights or white lights during 3 or 4 hours from the bottom time is known to make the phase of circadian clock in-advance.

2) We can recommend cows' milk and fermented soy beans called *Natto* as breakfast menu. Because 98% of nutrition in *Natto* can be digested and absorbed into the body, much amount of tryptophan as a precursor of serotonin can be took into the body from only small amount of *Natto*. However, cows' milk is the best recommendation, because it can be easily bought (cheep and any kinds of shops we can get) and taken. Let's drink cows' milk like as Japanese tea in the morning! Our research on the infants living in Kochi city showed that the infants who took only cows' milk at the breakfast were more morning-typed than those taking carbohydrate only. Of course, bacon, dry fishes and cooked fishes and so on are effective for the serotonin synthesis like as cows' milk and *Natto*. Anyway, please add one dish (as protein resource) into breakfast menu. Most of foods as protein-resources include much amount of Vitamin 6, and are effective for serotonin synthesis themselves. Vegetables and fruits are also effective for serotonin synthesis as Vitamin 6 resources.

3) Serotonin synthesis during daytime can make concentration of humans increased! Much knowledge has been accumulated from several researches on infants in Kochi city and students attending soccer club in Kochi University. When infants take protein (tryptophan) resources like as *Natto* and cows' milk and also resources of Vitamin 6 (co-enzyme for serotonin synthesis), and after that when they are exposed to the sun-lights, much amount of serotonin can be synthesized in their brain (pineal) from tryptophan in the morning. Due to this synthesis, infants can become more powerful mentally with high concentration. The melatonin can be synthesized at night from serotonin at the same part (pineal) of their brains. Melatonin can act as sleep onset substance at night to children's brains.

4) Please use the lightings emitting orange-colored lights at night. Reasons (evidences): Melatonin can be fully synthesized and secreted into plasma with-

out being suppressed by “white lights” and children can fall in sleep smoothly at night with sufficient plasma melatonin. Blue lights with wave length of about 460 nm (absorbance peak for melanopsin as a key receptor to control melatonin and circadian clock phase) which are included in the white lights emitted from fluorescent lamps, can suppress melatonin synthesis down into zero for elementary children and down into one third for junior high students (evidences). Lightings for daytime are recommended to be fluorescent lamps (white lights) like as “sun lights”. Lightings for night are recommended to be lightings emitting orange lights (lights at fire places at home or candle lights and “moon lights”)

5) Please make the duration of watching TV and playing game for infants limited within 1 hour. The number of children to play game actively at night, increases from the middle grade of elementary school in Japan. When they watch TV and play game more than 1 hour per night, sleep health and mental health of infants and elementary school students were worse based on research evidences which showed that watching TV and playing game every day had negative effects on their health. Please make off-day for watching TV and playing game for infants. The blue lights emitted from TV displays can lead to suppress the melatonin synthesis and disturb the onset of sleep for infants. The TV watching at night should be avoided for small children.

6) *Timing for growth hormone synthesis and secretion into the body* Timing of secretion of growth hormone can be about 20:00-21:00 for children and about 23:00 for adults (directly caused by body temperature decrease). If infants and adults awaken still in this time, the amount of growth hormone can be decreased. The growth hormone is known to be secreted at the timing of slow wave sleeps (Stages 3 and 4) in Non-REM sleep. Therefore, being awoken at late time can lead to lower growth for children and lead not to be repaired of damaged tissues (related to beauty and aging) for adults.



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