

# Usage of Mobile Phone in The Evening or at Night Makes Japanese Students Evening-typed and Night Sleep Uncomfortable

Tetsuo Harada, D.S., Mami Morikuni, B.E., Sato Yoshii, B.E., Yasuhiro Yamashita, B.A., Hitomi Takeuchi, M.E.

24 hours society is rapidly advancing in JAPAN: convenience stores and so-called "Family-Restaurant", broad-casting radio and TV programs, and Internet programs, all of which we can enjoy 24-hours. Mobile phone is very convenient equipment for communication anywhere and anytime and now rapidly distributed not only to university students but also to young students in Japan. An epidemiological work was done on the effects of mobile phone usage by Japanese junior high school students (aged 13-15y), and university and physical therapist or nurse training school students (aged 18-25y) on morningness-eveningness preference and sleep habit. Everyday usage of mobile phone made the younger students more evening-typed, their wake-up timing delayed and their sleep hours shorter. Usage of mobile phone more than 20 min. per once usage made the elder students more evening-typed, their sleep latency longer, and them feel difficult to fall in sleep more frequently. Shifting to evening-typed partially caused by the usage of mobile phone can be possible to make psychiatry problems on the students which are supposed to be caused by internal de-synchronization of two circadian oscillators in humans. Usual usage of mobile phone in the evening or night might become effective "Electromagnetic and/or Psychological Zeitgeber(s)" for circadian oscillator driving sleep-wake cycle of Japanese students from chronobiological point of view. **(Sleep and Hypnosis 2002;4(3):149-153)**

**Key words:** mobile phone, morningness-eveningness preference, sleep habits, circadian oscillators

## INTRODUCTION

Twenty-four hours society is rapidly advancing in JAPAN. For example,

From the Laboratory of Environmental Physiology, Faculty of Education, Kochi University, Kochi (Drs. Harada, Morikuni, Yoshii and Takeuchi); Motoyama Junior High School, Nagaoka District, Kochi Prefecture (Dr. Yamashita); and Department of Human and Cultures, Graduate School of Nara Women University, Nara (Dr. Takeuchi), Japan

Acknowledgements: This study was supported by the Japan Securities Scholarship Foundation of 1999-2000 (T. Harada) and Government Fund by Ministry of Education, Sciences, Culture, Sports and Arts, Project No. 11794001 (T. Harada).

Address reprint requests to: Dr. Tetsuo Harada Laboratory of Environmental Physiology, Faculty of Education, Kochi University, Kochi 780-8520, JAPAN

Accepted September 13, 2002

convenience stores supplying foods, several staffs for life (etc. soap, shampoo, underwear, toothbrush), news paper, magazines and drinks with or without alcohol and so on, and special kind of restaurants for family members to enjoy are 24 hours-opened and can be seen very abundantly and commonly in Japan. In addition to that, we can enjoy several broad-casting radio and TV programs which continue to be on air for 24 hours in Japan. Several information can be got by accessing to Internet programs for 24 hours all over the world through personal computer.

Mobile phones are rapidly distributed especially to young generations and we can use them anywhere and anytime. On an epidemiological work (2260 students aged 10-11y at the fifth grade of elementary school and 2910 ones aged 13-14y at the second grade of junior high school from all over Japan) done by Japan Parents and Teachers Association (PTA) in 2001, 6.7% and 16.3% of 10-11y and 13-14y students had their own mobile phone. Seventy-four percent of the elementary school students used it to communicate with their family, while 57% of the junior high students used it for communication with their colleagues (1). Japanese students, especially women students, tend to communicate with their friends at the night (even in Midnight after 0:00 AM) sometimes more than 1 hour.

Three aspects above might become physical or psychological zeit-gebers for circadian clock of Japanese students. For example, frequent usage of convenience store after sun-set makes Japanese junior high school students more evening-typed, based on an epidemiological work (Harada et al., unpublished). Probably exposure to bright light with the luminance more than 2000 Lx inside the store could function like as "a pulse light " for circadian clock of junior high-school students and the phase of sleep-wake cycle would be delayed. This speculation can be supported by "a light pulse experiment on human" (2): exposure to bright light with 5000 Lx during the first half of subjective night promotes the phase-delay in sleep-wake rhythm of human beings. In this study, we will report an epidemiological work on the effects of mobile phone usage by Japanese junior high school students (aged 13-15y), and university and physical therapist or nurse training school students (aged 18-25y) on morningness-eveningness preference and sleep habit.

## METHODS

A Japanese version (modified for school

students) of Morningness-Eveningness Questionnaire (MEQ) Torsvall and Åkerstedt (3) constructed and an original questionnaire were prepared, which was including questions on sleep habit (etc. bed-in or -off timing, sleep duration, interruption during sleep, difficulty to fall into sleep) and on usage of mobile phone, focusing on the frequency: "How many times do you use mobile phone per one week?----5 selections: everyday, 4 or 5 times per week, 2 or 3 times, 0 or 1 time, I don't have mobile phone.", the time of day: "When do you use it mainly in weekdays?-----8 selections: 6:00-9:00, 9:00-12:00, 12:00-15:00, 15:00-18:00, 18:00-21:00, 21:00-24:00, 24:00-3:00, 3:00-6:00.", and the duration of usage per one time: "How long do you use it per once?-----6 selections: 1-5 min, 5-10 min, 10-20 min, 20-40 min, 40-60 min, longer than 60 min". In 2001, the questionnaires were filled in by 613 (296 women, 317 men) students aged 12-15y attending to a junior high school located in a suburb area of Nangoku city (33°N) in Kochi Prefecture and by 367 (221 women, 146 men) students aged 18-25 y attending to Kochi University located in Kochi (33°N), physical therapist training schools or nurse training school in Kochi Prefecture. All of Kochi University and three schools were located in relatively suburb areas.

## RESULTS

18.1% of the students aged 13-15 y and 97.6% of those aged 18-25y had their own mobile phone, respectively. Of the students having their own mobile phone, 64.9% (women: 76.7%, men: 55.6%) of the students aged 13-15 y and 89.4% (women: 91.7%, men: 86.2%) of those aged 18-25 y used it everyday, and 39.1% (women: 50.0%, men: 32.6%) aged 13-15 y and 60.0% (women: 59.6%, men: 60.4%) aged 18-25y used it after 21:00. How long did students use their own mobile phone per one time? Of the students aged 13-15 y and 18-25y, 38.5% (women: 30.4%, men: 44.4%)

(Figure 1) and 42.9% (women: 37.3%, men: 51.0%) used it less than 5 min per once (Figure 1). On the other hand, 15.6% (women: 28.3%, men: 6.3%) of students having mobile phone aged 13-15y (Figure 1) and 6.0% (women: 6.5%, men: 5.4%) aged 18-25y used it more than 60 min per once.

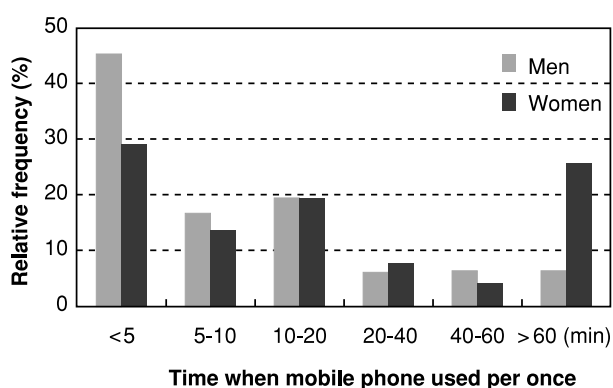


Figure 1. Answer of Japanese students aged 13-15y to "How long do you use mobile phone per once?"

Students aged 13-15y who used mobile phone every day were more evening-typed rather than those who didn't do that every day

(Kruskal-Wallis test;  $\chi^2=14.60$ ,  $p<0.001$ ) (Figure 2). Students aged 13-15y who used it more than 60 min per one time were more evening-typed (Mean $\pm$ SD of ME score=12.47 $\pm$ 2.24(17)) rather than those who used it less than 60 min (15.18 $\pm$ 3.78 (493) (Mann-Whitney U-test;  $z=-3.139$ ,  $p=0.002$ ). When they used it more than 20 min, the students aged 18-25y were more evening-typed rather than those who used it less than 20 min (Kruskal-Wallis test;  $\chi^2=4.69$ ,  $p=0.03$ ). Students aged 13-15y who used their own mobile phone every day have slept shorter hours rather than those who didn't do that (Kruskal-Wallis test;  $\chi^2=5.59$ ,  $p=0.018$ ).

Students aged 13-15y and 18-25y who used mobile phone every day have waken up significantly later than those who didn't use it every day (Kruskal-Wallis test; 13-15y:  $\chi^2=13.11$ ,  $p<0.001$ , 18-25y:  $\chi^2=4.82$ ,  $p=0.028$ ). Subjective sleep latency was longer by the students aged 18-25y who used it more than 20 min per once rather than that by students who used it less than 20 min (Kruskal-Wallis test;

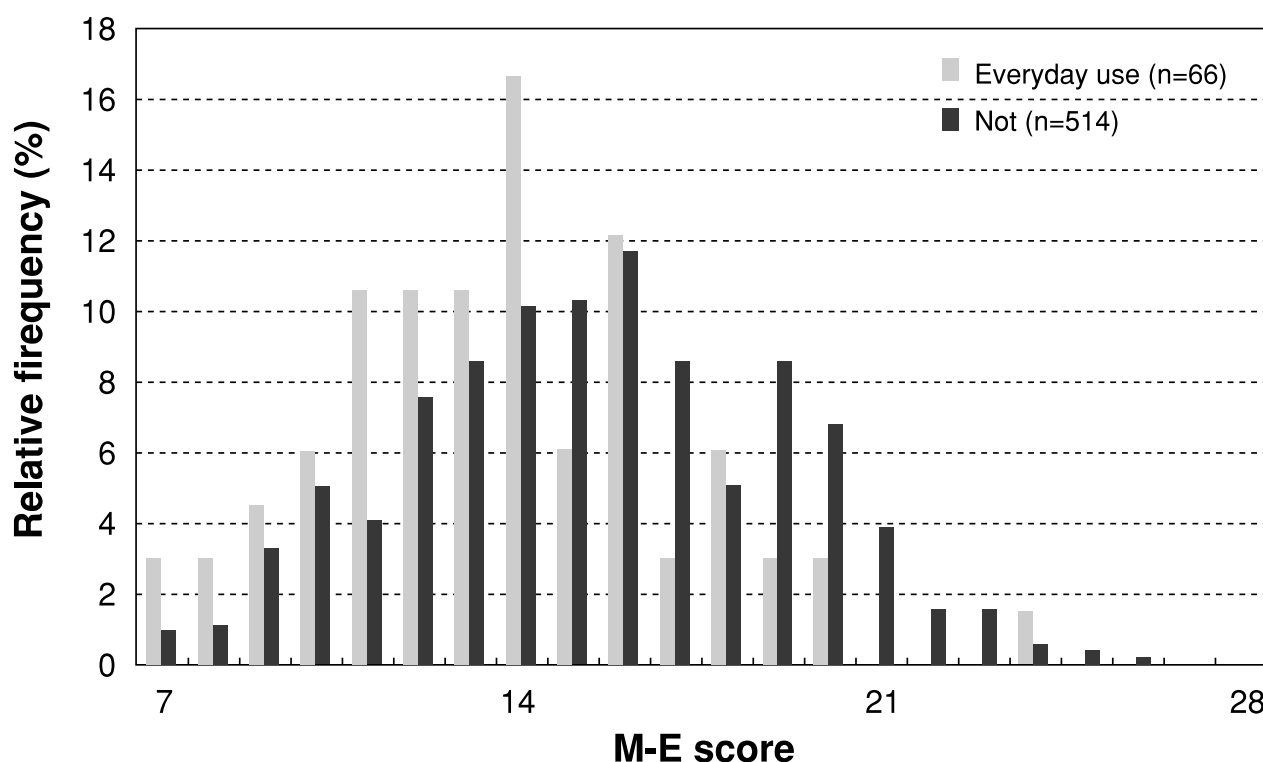
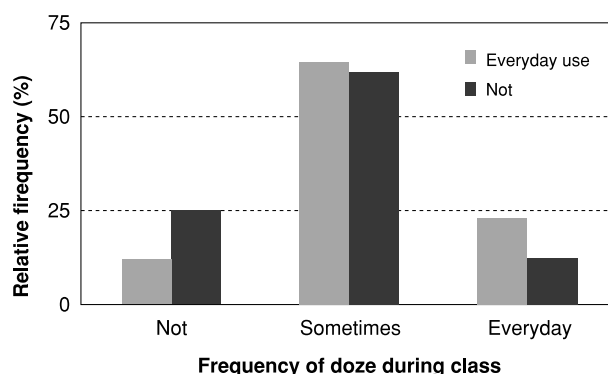


Figure 2. Usage of mobile phone every day makes Japanese students aged 13-15y evening-typed.



**Figure 3.** Usage of mobile phone everyday by the students aged 18-25y makes the "doze" during classes occur more frequently rather than when they didn't use it everyday.

$\chi^2=12.46$ ,  $p=0.006$ ). The more frequently they used it, the more frequently students aged 18-25y could feel difficult to fall in sleep (Kruskal-Wallis test;  $\chi^2=12.46$ ,  $p=0.008$ ). Students aged 18-25y who used it longer than 20 min per once have felt difficult to fall into sleep more frequently than those who used it less than 20 min (Kruskal-Wallis test;  $\chi^2=13.79$ ,  $p=0.008$ ). Students aged 18-25y who have used their own mobile phone every day have felt difficult to wake up in the morning more frequently rather than those who didn't use it everyday ( $\chi^2$  test;  $\chi^2=22.21$ ,  $p<0.001$ ).

The usage of mobile phone everyday by the students aged 18-25y made the "doze" during classes occur more frequently rather than when they didn't use it everyday ( $\chi^2$  test:  $\chi^2$  cal=7.58,  $p=0.023$ ) (Figure 3). More students aged 18-25y who used it everyday could not wake up easily without any equipment like alarm rather than those who didn't use it everyday ( $\chi^2$  test;  $\chi^2=13.21$ ,  $p=0.010$ ). In the students aged 13-15 y, the usage of mobile phone everyday made their bedtime delayed ( $\chi^2$  test;  $\chi^2=10.93$ ,  $p<0.001$ ) and wake-up timing also delayed ( $\chi^2$  test;  $\chi^2=11.17$ ,  $p<0.001$ ) in weekdays. More students aged 13-15y who used it every day have felt unsatisfied for current sleep duration rather than those who didn't use it everyday ( $\chi^2$  test;  $\chi^2=8.18$ ,  $P=0.042$ ). Students aged 13-15 y who used it more than 20 min have stayed in bed even after awakened in the weekends longer ( $\chi^2$  test:  $\chi^2=11.98$ ,  $df=3$ ,  $p=0.007$ ), and

they dozed more frequently during daytime rather than those who used it less than 20 min ( $\chi^2$  test:  $\chi^2=6.08$ ,  $df=2$ ,  $p=0.048$ ).

## DISCUSSION

The everyday usage of mobile phone in the evening or night has possibility to make circadian clock phase of Japanese students especially aged 13-15 delayed. The delay in the phase may cause less fitness to their school life schedules. Shorter sleep hours caused by delayed bedtime may cause frequent occurrence of "doze" during daytime. The results in this paper seem to show that 20min in the evening or night is a critical duration to affect circadian oscillations of Japanese junior high school and university students.

About 30% of women students who have their own mobile phone have used it more than 1 hour per one day. These students taking such a long time call showed very low ME-score of 12.47 on average (the others: 15.18). In the urban area in Kochi, more than 30% of all students had their own mobile phones in the fall of 2001 (Harada, unpublished). If the distribution of mobile phone is in advance, the number of women junior high students taking a long time call will increase. The long call more than 1h in the evening seems to be dangerous for keeping health of Japanese women junior high students from not only physical but also mental point of view, because the shifting to evening type induces lower mood of them (4). The significant shifting to evening-type which has been shown only for women could be partially caused by relatively long time use of mobile phone (5).

What kind of "zeitgeber" for human beings does the usage of mobile phone become? Recently, Jarupat et al (6) have shown by an experiment that electromagnetic wave emitted from mobile phone depressed the concentration of blood melatonin in humans. In addition to that, psychological tension seems to be very high during the usage of mobile phone in the

late evening or midnight especially for Japanese women junior high school students, because they have to be in contact continuously through the day via mobile phone with their colleagues: if she cannot reply promptly a message from colleague even in the midnight she should be out of the circle of the colleagues in some cases

(Personal communication with health keeping teachers in a Junior high school). Usual usage of mobile phone in the evening or night might become effective "Electromagnetic and/or Psychological Zeitgeber(s)" for circadian oscillator driving sleep-wake cycle of Japanese students.

## REFERENCES

1. *The Sankei* 15th March 2001, pp 29. (In Japanese).
2. Honma K, Honma S. A human phase-response curve for bright light pulses. *Jap J Psychiat Neurol* 1988;42:167-168.
3. Torsvall MD, Akerstedt T. A diurnal type scale: construction, consistency and validation in shift work. *Scand J Work Environ Health* 1980;6:283-290.
4. Takeuchi H, Morisane H, Iwanaga A, Hino N, Matsuoka A, Harada T. Morningness-eveningness preference and mood in Japanese junior high school students. *Psychiatry and Clinical Neurosciences* 2002;56:227-228.
5. Harada T, Takeuchi H. Epidemiological study on diurnal rhythm and sleep habit of Japanese students aged 10-25 y (a review). (in Japanese) *Annals of Japanese Society for Chronobiology* 2001;3:37-46.
6. Jarupat S, Kawabata A, Tokura H, Borkiewicz A. Effects of the 1900 MHz electromagnetic field emitted from cellular phone on nocturnal melatonin secretion. *Journal of Physiological Anthropology* 2002; in press.