Relaxing Music Increases Sleep Spindles and Improve Sleep Quality*

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Abstract—**Insomnia is a highly prevalent sleep disorder. A simple way to improve sleep quality has great importance. In this study, we analyzed EEG data recoded from subjects during sleep in three types of sound environments: silence, environmental noise, and relaxing music. We used an automatic spindle detection algorithm to evaluate the sleep quality from the viewpoint of spindle occurrence. The results showed that the number of sleep spindles increased in seven of eleven subjects. Among five subjects with poor sleep efficacy, four subjects had increased number of spindles under the relaxing music environment. This study indicated that the relaxing music environment could improve the sleep quality, particularly in subjects with insomnia.**

I. INTRODUCTION

Insomnia is a highly prevalent sleep disorder among workers, which may have deleterious effects on work productivity. To improve the sleep quality is great importance for economic activities as well as public health. In this study, we analyzed overnight EEG from healthy adults in three types of sound environments: silence, environmental noise, and relaxing music, with the aim of investigating the differences in the appearance of sleep spindles which are EEG activity characterizing Stage N2 and related to learning and cognition.

Music has been widely used as a tool to improve sleep quality [1]. Some experiments have shown that music has a positive effect on sleep in various age groups. Since the standard EEG-based sleep scoring requires visual annotations by sleep specialists, which is time-consuming and burdensome. In this study, we adopted a spindle detection algorithm named SST-RUS developed by Kinoshita *et al.*[2] in order to detect spindles automatically and precisely. SST-RUS has been validated with MASS-C1 [2].

We compared the number of spindles in three types of sound environments within each subject to investigate whether the relaxing music improves the quality of sleep or not.

II. METHOD

A. *YAMAHA Dataset*

The objective dataset was the PSG data of three nights recorded from eleven adult males during sleep in three types of sound environments: silence, environmental noise, and relaxing music for all night. The relaxing music adopted in this study was developed by YAMAHA corporation. The

protocol was approved by the ethical committee at Shiga University of Medical Science (Approved #26-227).

B. *Comparison*

The numbers of spindles in the noisy and relaxing music environments were compared with those in the silent condition using a paired-samples t-test with a significance level of 5%.

III. RESULTS

Fig. 1 shows the number of sleep spindles of Subject 6. The vertical line is the ratio of the numbers of spindles in the noisy and the relaxing environments to in the silence environment. The spindle detection results showed that the number of spindles increased significantly in seven of eleven subjects. ($p < .05$)

In addition, in five subjects with poor sleep efficacy, the relaxing music significantly increased the number of spindles in four subjects.
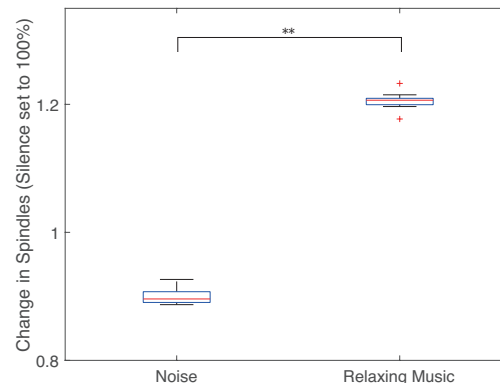

Fig. 1. Comparison of number of sleep spindles (Subject 6)

IV. CONCLUSION

This study showed that the relaxing music increased the number of spindles particularly among subjects with poor sleep efficacy, which indicates that the relaxing music may improve the sleep quality of subjects with insomnia.

In the future, we will investigate essential sound elements for improving sleep quality, which contributes to guiding composition of music for good sleep.

REFERENCES

[1] Jespersen, Kira V., et al. ″Music for insomnia in adults.″ Cochrane Database of Systematic Reviews 8 (2015).

[2] Kinoshita, Takafumi, et al. ″Sleep Spindle Detection Using RUSBoost and Synchrosqueezed Wavelet Transform.″ IEEE Transactions on Neural Systems and Rehabilitation Engineering 28.2 (2020): 390-398.