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Night Mode Life Style and Shorter Healthy Life Expectancy: Physiological Big Data Project, Allostatic State Mapping by Ambulatory ECG Repository (ALLSTAR)

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1. Introduction

Allostatic State Mapping by Ambulatory ECG Repository (ALLSTAR) Research Group has been accumulating 24-hr Holter ECG and physical activity data since 2009 and has built a big data comprising >300 thousands of data, which are associated with date and geographic data (postal codes)[1].

The purposes of ALLSTAR project are to increase the clinical utility value of Holter ECG monitoring by establishing new methods for evaluating the effects of environmental factors on health and diseases from the data recoded in entire Japan and to contribute the progress in predictive and preventive medicine for aging society.

Among about 300 thousands of data already collected by the ALLSTAR project, about 43 thousands were recorded with micro Holter ECG recorders with built-in 3-dimensional acceleration sensor (Cardy 303 pico, SUZUKEN CO., LTD), which allowed us to analyze the changes in physical activities and body postures in daily life.

In the present study, we assessed the body postures during 24 hr and examined if the ratio of time in the lying position during day is associated with the regional difference in healthy life expectancy (HALE).

2. Methods

We studied 3-dimensional acceleration data obtained with Holter ECG recorders (Cardy 303 pico, SUZUKEN CO., LTD) that were analyzed between April 2012 and July 2014 at three ECG analysis centers (Sapporo, Tokyo, and Nagoya) in Japan. We used data only from subjects >20 yr who have agreed with the usage of the data for this study. The protocol of this study has been approved by the Research Ethics Committee of Nagoya City University Graduate School of Medical Sciences (No. 709).

3. Data analysis
<3.1> Estimation of ratio in the lying position

The lying position was determined from the value of acceleration in Y axis (caudo-cranial direction) that comes close to 0 during lying. Then, the percentage of time in the lying position was calculated for 24 hr (pLP_{24}) and for every hour (pLP).

<3.2> Statistical analysis

The data in each gender were divided into the tertiles (3 subgroups) according to the HALE ranking of prefectures published by the Japanese Health, Labour, Welfare Ministry[2]; upper (L1), middle (L2), and lower (L3) HALE areas. Data in each gender were also divided into 5 groups with subject's age; 20-39, 40-49r, 50-59, 60-64, 65-69 yr; and further divided in each group into tertiles with the prefecture HALE ranking.

In each sex and age group, pLP_{24} and pLP in each hour were compared among L1, L2, and L3 by ANOVA with a type 1 error level of 0.05. Med Calc Ver.14.12.0 was used for statistical analysis.

4. Results

Data were obtained from 18875 men (age, 66 ± 14 yr) and 23541 women (69 ± 15 yr) and 20% of them were recorded in Tokyo, 10% in Hokkaido, 8% in Saitama, 7% in Kanagawa, 6% in Aichi, 6% in Osaka, 5% in Toyama, 4% in Hyogo, and 4% in Fukuoka, which comprised 70% of all data. Among these prefectures, Aichi and Kanagawa were classified to L1, Hokkaido and Saitama to L2, and Tokyo, Osaka, and Fukuoka to L3. Toyama was classified to L2 in men and to L1 in women.

Fig 1 shows mean $\pm$ SE of pLP_{24} in each age group. The associations of pLP_{24} with HALE ranking existed in all age groups but 20-39 yr in men and in 20-39, 60-64, and 65-69 yr in women. For these age groups, pLP_{24} was lower in L1 group.

In men of 50-59 yr, pLP was higher in L3 between 13h and 19h, lower between 00h and 04h, and higher between 7h and 12 h. In women of 20-39 yr, pLP was lower in L3 between 22h and 00h and higher between 06h and 09h.

5. Discussion

In the prefectures with the upper ranking of HALE, pLP_{24} was lower and increased with the rank of HALE in men above 50 yr. From the results for 50-59 yr, men in the areas with upper HALE ranking are more likely to spend in upright positions during daytime and to keep early hours (early to bed and early to rise).

Because L3 included large cities such as Tokyo and Osaka, there are differences in residential amenities, economic force, and type of business from areas in L1
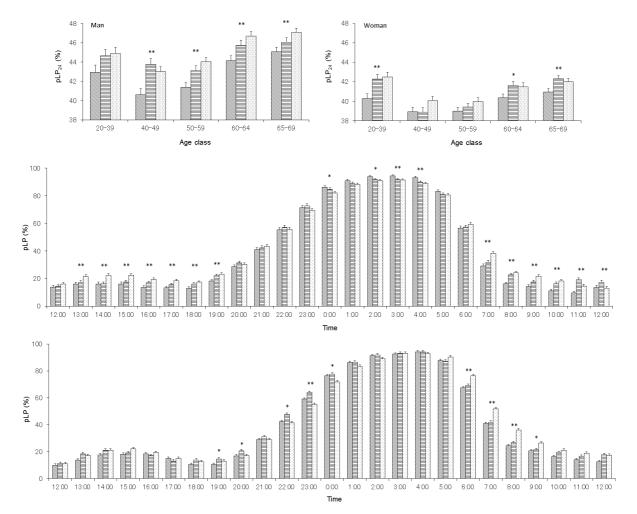
Fig. 1. Percentage of time in the lying position (pLP) in the areas divided by the ranking of HALE.
Upper panels: all subjects classified into age groups. Middle panels: men in 50-59 yr group.
Lower panel: women in 20-39 yr group. Fine dotted, horizontal hatched, and coarse dotted bars
indicate upper, middle, and lower tertiles of HALE, respectively. Data are mean ± SE. **P <0.01, *P <0.05.

and L2, which may cause the difference in lifestyle. We have reported elsewhere that regional difference in physical activity is associated with that in HALE in men after 50 yr of age. Together with the present study, physical activity and ratio in the lying position after 50 yr of age may be associated with HALE in men.

6. Summary

Holter ECG big data in the ALLSTAR project are increasing by 60 thousand data every year. To promote the extension of HALE, the project plans to build age- and gender-specific database of physical activity and lifestyle.

References
(1) Allostatic State Mapping by Ambulatory ECG Repository (ALLSTAR) Research, http://www. med.nagoya-cu.ac.jp/mededu.dir/allstar/
(2) Progress of each goal in Healthy Japan 21 (2nd stage), the Ministry of Health, Welfare, and Labour, http://www.mhlw.go.jp/file/05-Shingikai-1060 1000-Daijinkanboukouseikagakuka-Kouseikagakuka/ sinntyoku.pdf