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論文の要旨 Abstract of Dissertation

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題 目 Title of Dissertation	The association between social jetlag and metabolic syndrome in the Japanese working population
<p>要 旨 Abstract</p> <p><i>Background:</i> Inadequate sleep duration has been found to be a key factor associated with metabolic syndrome (MetS) and lifestyle diseases. In addition, previous studies showed an association between social jetlag, the discrepancy in the midpoint of sleep between weekdays and weekends, with MetS and lifestyle diseases. However, most studies measured sleep time with a subjective method such as a self-reported questionnaire, and the actual sleep time and sleep patterns of Japanese people are unclear. Therefore, we conducted three studies, and each primary aim was 1) to examine the cross-sectional association between total sleep time (TST) and high-density lipoprotein cholesterol (HDL-C), one of the components of MetS, (Study 1), 2) to describe three-year sleep tendencies including social jetlag, sleep-wake schedules, and TST on weekdays and weekends (Study 2), and 3) to examine the longitudinal association between sleep variables including social jetlag and the incidence of pre-Mets/MetS (Study 3), using a validated wearable device for sleep, Fitbit, in a working population in Japan.</p> <p><i>Methods:</i> Study 1 was a secondary analysis of a subset of participants from a randomized controlled trial from December 2018 to March 2019. The participants of Study 1 were 179 individuals who participated as the intervention group in a three-month lifestyle intervention study among office workers with MetS or at risk of MetS. The number of participants for Study 1 was 173 individuals (8,323 observations). The participants of Study 2 were 10,670 individuals (5,156,835 observations) who were insured by Japanese health insurance associations in agreement with JMDC Inc. For Study 3, we used three separate samples. Eligible participants were those who had baseline and follow-up annual health check-up data and who had sleep records from a wearable device, Fitbit, at least six months prior to the baseline annual health check-up. We applied exclusion criteria, having sleep apnea syndrome, having psychotropic medication, eating disorder, malignant neoplasm, pregnant women and women who gave birth with medical treatment. Sample 1 consisted of the participants who had a baseline annual health checkup and sleep records in 2019 and had a follow-up annual health checkup in 2020; Sample 2 consisted of those who had had a baseline annual health checkup and sleep records in 2020 and</p>	

a follow-up annual health checkup in 2021; and Sample 3 consisted of those who had a baseline annual health checkup and sleep records in 2021 and a follow-up annual health checkup in 2022. The number of participants in Sample 1 was 810 participants with 91,903 observations, 1,930 participants with 258,601 observations in Sample 2, and 3,315 participants with 454,829 observations in Sample 3.

MetS and pre-MetS determinations were defined by the Japanese MetS criteria. Social jetlag was categorized into three groups based on the gap in mid-sleep time between weekdays and weekend (0 to less than 1 hour, 1 hour to less than 2 hours, and 2 hours or more). The baseline characteristics, MetS variables, covariates, and exclusion criteria were derived from the individuals' health claim data and annual health check-up data.

Multiple linear regression models were used to examine the cross-sectional association between TST and HDL-C for Study 1. The t-test was used for continuous variables, and the chi-square test was used for categorical variables for Study 2. The midpoint of sleep time was considered both continuous and binary (per one-hour cutoff). These tests were performed by comparing gender and age groups. Modified Poisson regression models were used to estimate the risk ratio to determine the association between social jetlag and pre-Mets/MetS (Study 3). Multiple linear regression models were used to examine the association between social jetlag and MetS components.

Results: Overall, compared to average TST of 5.9-7.2 hours, average TST of 4.0-5.3 hours (-4.82 mg/dl; 95% CI: -9.22, -0.43) was inversely associated with HDL-C in Study 1. In Study 2, TST, sleep-wake schedules, and social jetlag differed by gender and age group, and TST was roughly 0.5-1.0 hours shorter on weekdays than on weekends for both men and women in all age groups. Women were likely to have greater social jetlag than men (the point estimate of the effect: -0.23 hours and 95% CI: -0.25; -0.20). In addition, the mid-sleep time on weekends in men between the youngest age group and over age 40 groups [between age 10-20 and 40 (the point estimate of the effect: 1.17; 95% CI: 1.05; 1.29), between age 10-20 and 50 (the point estimate of the effect: 1.49; 95% CI: 1.37; 1.62), between age 10-20 and 60-70 (the point estimate of the effect: 1.75; 95% CI: 1.58; 1.91)], and the youngest age group was significantly later than older age groups.

In Sample 1 for Study 3, greater social jetlag was associated with the incidence of pre-Mets and MetS (risk ratio: 2.81; 95% CI: 1.03; 7.69) compared with social jetlag <1 hour, and the association was significant in all adjusted models. In addition, social jetlag \geq 2 hours was associated with systolic blood pressure in all adjusted models (11.24 mmHg; 95% CI: 4.26; 20.55) increase compared with social jetlag <1 hour. In Sample 2 and 3, there was no association between social jetlag and the incidence of pre-Mets and MetS. In Sample 3, the <2 hours social jetlag was associated with diastolic blood pressure in adjusted models (2.98 mmHg; 95% CI: 0.47; 5.49) increase compared with social jetlag <1 hour.

Conclusion: The shortest average TST was inversely associated with HDL-C. Large-scale data demonstrate average habitual sleep duration, sleep-wake schedules, and social jetlag. These sleep patterns vary by age and gender. Although greater social jetlag may be associated with the risk of MetS in the short term, the number of sleep observations, sleep calculations, and the duration between baseline and outcomes should be reconsidered to adequately examine the longitudinal association between social jetlag and the incidence of MetS for the future studies.

Keywords

Japanese working population, metabolic syndrome, real-world data, social jetlag, total sleep time, wearable device.

(974 words)

(注) 内容は 2,000 字程度とすること

(Note) Please describe the abstract within approx. 2,000 letters in Japanese or 1,000 words in English.