Subjective Poor Sleep and White Blood Cell Count in Male Japanese Workers

Naoko NISHITANI and Hisataka SAKAKIBARA*

Department of Nursing, Nagoya University Graduate School of Medicine, 1-1-20 Daiko-minami, Higashi-ku, Nagoya 461-8673, Japan

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Abstract: Sleep deprivation has been shown to be associated with an increase in inflammatory makers such as interleukin-6 and C-reactive protein. The purpose of the present study was to investigate the relation between subjective poor sleep and white blood cell (WBC) count, an inflammatory marker. The subjects were 208 male Japanese workers in a synthetic fiber-manufacturing plant, who responded to a cross-sectional survey of a questionnaire on basic attributes, life style, and sleep. All male workers in the plant took an annual health checkup. WBC count was also examined in the checkup. The WBC count was greater in shift workers than in daytime workers. Shift workers complained of poor sleep more frequently, though their sleeping hours were longer. Multiple regression analysis showed that poor sleep as well as smoking habit, BMI and age were independent factors for an increase in WBC count, while sleeping hours and work pattern (shift work) were not significant factors. The present finding that poor sleep was associated with higher WBC count in male workers might suggest the importance of quality of sleep, particularly among shift workers.

Key words: White blood cell, Life style, Poor sleep, Quality of sleep, Shift work

Introduction

Sleep deprivation has been recently shown to be associated with inflammatory responses such as interleukin-61, 2), high-sensitive CRP and white blood cell (WBC) count3, 4). Sleep deprivation is reportedly related to elevations in CRP and WBC count3, 4). Sleep deprivation also causes an increase in interleukin-6 during the day after sleep deprivation5). In addition, an association between interleukin-6 and depth of sleep has been indicated1, 2). An increase in these inflammatory indicators is known to be associated with coronary heart disease and subclinical atherosclerosis5). Recent studies have shown that WBC count is useful as an indication of inflammation that is related with risk factors for coronary heart disease6, 7). Generally, it is also known that an increase in WBC count is associated with smoking, obesity, and hyperlipidemia12–14).

Earlier findings of an association between sleep and inflammatory responses have been obtained from experimental studies. However there have been few studies on the relation between WBC count and poor sleep in factory workers. The purpose of the present study, therefore, was to examine the relation between WBC count and subjective poor sleep in male Japanese workers.
Materials and Methods

Subjects
The subjects were 214 male workers of a synthetic fiber-manufacturing plant, who received an annual health check between March and May 2003. All male workers in the plant took the health check. Employees in this plant include daytime workers (8:30–17:00) and shift workers who work rotating shifts comprising morning (7:00–14:00), afternoon (14:00–22:00), and night (22:00–7:00) shifts (Table 1). Both white-collar workers and blue-collar workers are assigned to daytime work and shift work, respectively. The health check was conducted in the morning. Shift workers took it in the morning of a day they worked the afternoon shift. On the day before the health check, shift workers worked the afternoon shift or had the day off.

Among 214 male workers, 210 people gave an informed consent for the present study (participation rate of 98.1%). Two of the respondents who were undergoing treatment for mental disorders were excluded, and the analysis was conducted with 208 persons (107 daytime workers and 101 shift workers) aged 19–60 yr (33.7 ± 12.3 (SD) yr).

This study has been approved by the ethics committee of the Nagoya University School of Medicine.

Survey contents
Self-completed questionnaire forms were conducted with the health check. The questionnaire included items on basic attributes and lifestyle, such as age, sex, work pattern, whether living together with family, job type, overtime working hours, sleeping hours, health condition, regular exercise and smoking habit, and alcohol consumption.

Sleep quality was assessed by the question “How often did you have poor sleep during the past month?” Response options were: almost never, sometimes, often and almost always. The question was included as an item of the Job Stress Questionnaire15).

WBC count was also examined in the health check. BMI (body mass index) was calculated from the height and weight at the time of the health check. WBC count was measured in a sample of venous blood by SRL. Inc (Tokyo, Japan), using a Sysmex XE-2100 or SE-9000 autoanalyzer. None of the present subjects had any acute inflammatory disease.

Analysis method
An analysis was conducted using the t-test and analysis of variance for basic attributes, lifestyle, and mean WBC count. Multiple regression analysis was conducted to find factors relevant to WBC count. To test for differences in mean WBC by work pattern and “poor sleep”, analysis of variance was used. All statistical analyses were done using SPSS 12.0J for Windows.

Results

Basic attributes, lifestyle and white blood cell count
WBC count was significantly associated with smoking habit (p<0.001), shift work (p<0.01), poor sleep (trend p=0.010), age (trend p=0.030), and BMI (trend p=0.049) (Table 2). Regular exercise (trend p=0.050) and overtime work (trend p=0.052) tended to be associated with higher WBC count. Further multiple regression analyses were conducted for all these items (Table 3). Significantly independent factors for WBC count were shown to be smoking habit (p<0.001), BMI (p=0.003), age (p=0.029) and poor sleep (p=0.049). Shift work was not a significant factor for WBC count (p=0.405).

Relation between poor sleep, work pattern and white blood cell count
The responses of “often” or “almost always” for poor sleep were counted in eight (7.5%) of daytime workers, compared with 25 (24.8%) of shift workers. Thus, shift workers had poorer sleep (p<0.001). On the other hand, the mean sleeping hours were 6.3 ± 0.9 h for daytime workers and 6.7 ± 1.0 h for shift workers, indicating a greater number of hours for shift workers (p=0.021). As shown in Table 2, sleeping hours were not significantly associated with WBC count.
Table 4 shows WBC count according to work pattern and poor sleep. Although a significant difference was encountered for WBC count with overall poor sleep (trend $p=0.010$), no difference was found in WBC count with either work pattern or poor sleep. However, the mean WBC count showed a tendency to be higher in shift workers than in daytime workers even with similar poor sleep, although the difference was not significant.

**Discussion**

In the relation between WBC count and life style-related factors, smoking and obesity are known to be generally linked
to an increase in WBC count\textsuperscript{12, 13}. The present results also showed a significant association of WBC count with smoking habit and BMI. In addition, the present multiple regression analysis indicated that poor sleep can be an independent factor for WBC count. Meanwhile, sleeping hours were not related to WBC count. Hence, it is thought that disturbances in quality and not just quantity of sleep may be more closely associated with an increase in WBC count. Recent studies have shown that sleep deprivation is related to elevations in high-sensitive CRP\textsuperscript{3}, and to stimulation of NK cell activity and an increase in WBC count\textsuperscript{4}. Sleep deprivation also causes an increase in interleukin-6 during the day after sleep deprivation, which is thought to be associated with sleepiness and fatigue during the day\textsuperscript{1}. Quality of sleep is also shown to be associated with interleukin-6\textsuperscript{1, 2}. Thus, it would seem that sleep disturbances could activate inflammatory response and contribute to cardiovascular disturbances. These earlier findings obtained from experimental studies may account for the present results of an association between poor sleep and WBC count in male workers.

Shift work disturbing daily rhythms is known to increase the risk for circulatory diseases such as coronary heart disease and hypertension\textsuperscript{9, 10}. Knutsson\textsuperscript{16} indicated that the pathological onset mechanism is deterioration of autonomic nerve regulatory function as a result of an imbalance in circadian rhythms, while others showed that hypertension and hypercholesterolemia, more often seen in shift workers, cause arteriosclerosis and the easier development of coronary heart disease\textsuperscript{17, 18}. It is also indicated that shift work may affect metabolic function and glucose tolerance\textsuperscript{19, 20}. All these things with shift work can promote vascular changes and contribute to arteriosclerosis and coronary heart disease.

In the present study, shift workers had higher WBC counts than daytime workers. This finding might partly account for previous findings that shift workers are more likely to develop arteriosclerosis\textsuperscript{17, 18}. However, shift workers had poorer sleep as well. The present multiple regression analysis showed that poor sleep was a significant factor in WBC count, while work pattern (shift work) was not. Even so, it might be noteworthy that, as shown in Table 4, the mean WBC count seems to be higher in shift workers than in daytime workers even with similar poor sleep. It is also presumed that shift work can cause poor sleep, and thereby might contribute to higher WBC count among shift workers. Effects of shift work on WBC count would be necessary to be studied further.

The present study showed that poor sleep may increase a risk for inflammatory changes in blood vessels leading to coronary heart disease. If risk factors such as smoking or obesity are added to poor sleep, the risk is thought to be increased even more. For this reason it would seem to be important that workers, particularly shift workers, maintain high quality sleep.

The present study was a preliminary study conducted on male Japanese workers in a synthetic fiber manufacturing plant. The number of subjects was somewhat limited, and blood sugar levels, cholesterol levels, and other blood test values were not examined. Further detailed studies are necessary with respect to the relationship between sleep disturbances and WBC count, an inflammatory indicator.

\textbf{References}


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\begin{table}[h]
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\begin{tabular}{lccccc}
\hline
Poor sleep & Daytime worker & & Shift worker & & Total & \\
 & Mean (SD) & n & Mean (SD) & n & Mean (SD) & n \\
\hline
Almost never & 5.9 (1.3) & 63 & 6.5 (1.4) & 33 & 6.1 (1.4) & 96 \\
Sometimes & 6.4 (1.9) & 36 & 6.8 (1.7) & 43 & 6.6 (1.8) & 79 \\
Often or almost always & 6.2 (1.2) & 8 & 7.1 (2.1) & 25 & 6.9 (1.9) & 33 \\
\hline
Trend $p$ & 0.213 & 0.192 & 0.010 \\
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\end{tabular}
\caption{Mean (and standard deviation) of white blood cell count in relation to work pattern and poor sleep}
\end{table}


