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Effect of long-term sleep restriction and subsequent recovery sleep on the diurnal rhythms of white blood cell subpopulations

Julie Lasselin, Javaid-ur Rehman, Torbjorn Åkerstedt, Mats Lekander, John Axelsson

Stress Research Institute, Stockholm University, Sweden; Department of Clinical Neuroscience, Karolinska Institutet, Sweden

Introduction

- Restriction or deprivation of sleep is associated with alterations in immune functions, such as modifications in immune cell numbers and activity and increased systemic levels of inflammatory markers, as well as alterations of circadian rhythms of immune cells.

- However, the dynamic changes that occur over the day of a ***prolonged but modest period of sleep restriction*** and subsequent recovery sleep on immune cell numbers and diurnal rhythms have never been investigated.

➔ **The present study aimed at assessing the changes in count and diurnal rhythms of white blood cell (WBC) subpopulations that develop over five days of restricted sleep, as well as the potential restoring effect of a subsequent 7-day period of sleep recovery.**

Patients and methods

Study protocol

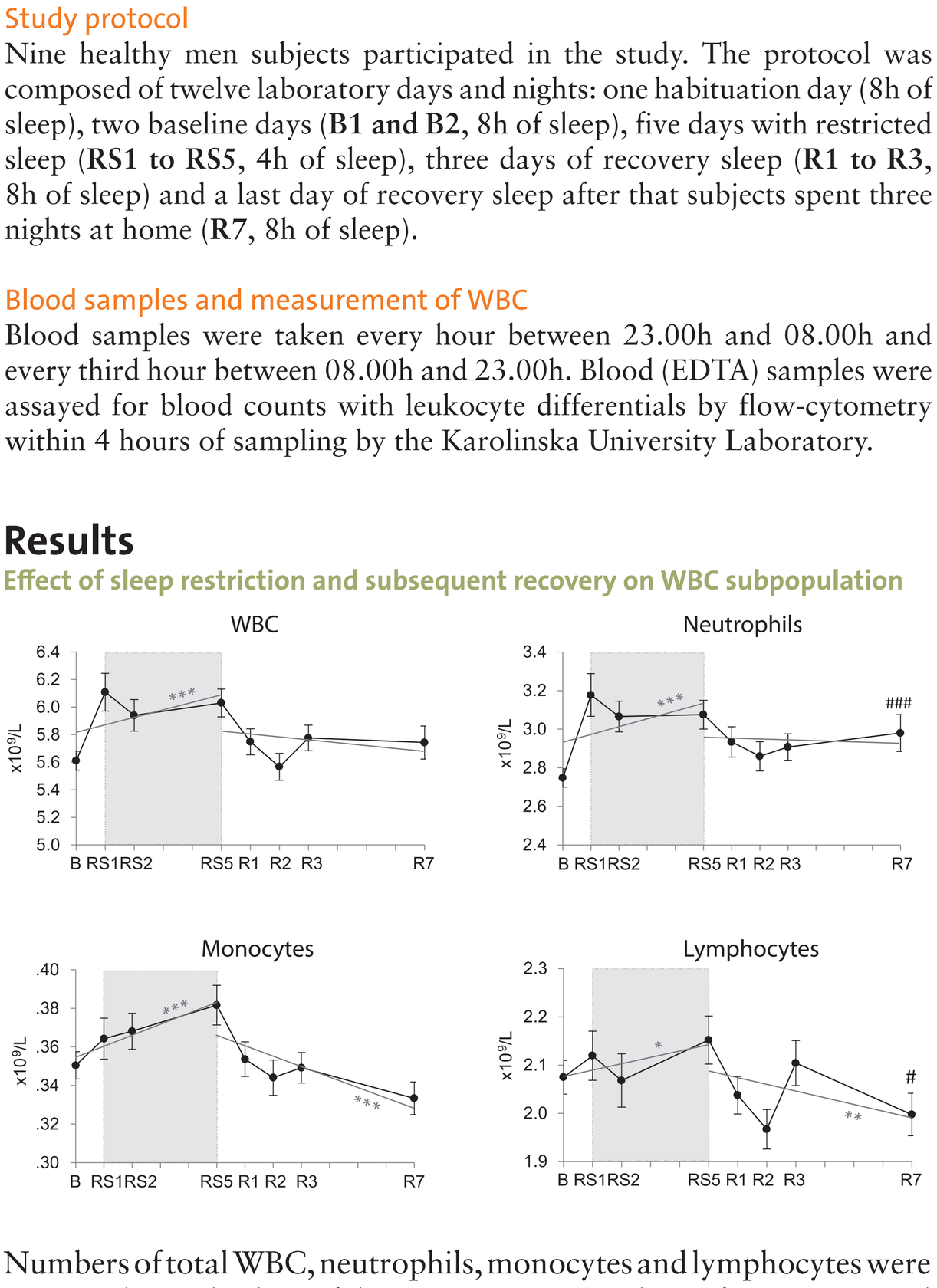
Nine healthy men subjects participated in the study. The protocol was composed of twelve laboratory days and nights: one habituation day (8h of sleep), two baseline days (**B1 and B2**, 8h of sleep), five days with restricted sleep (**RS1 to RS5**, 4h of sleep), three days of recovery sleep (**R1 to R3**, 8h of sleep) and a last day of recovery sleep after that subjects spent three nights at home (**R7**, 8h of sleep).

Blood samples and measurement of WBC

Blood samples were taken every hour between 23.00h and 08.00h and every third hour between 08.00h and 23.00h. Blood (EDTA) samples were assayed for blood counts with leukocyte differentials by flow-cytometry within 4 hours of sampling by the Karolinska University Laboratory.

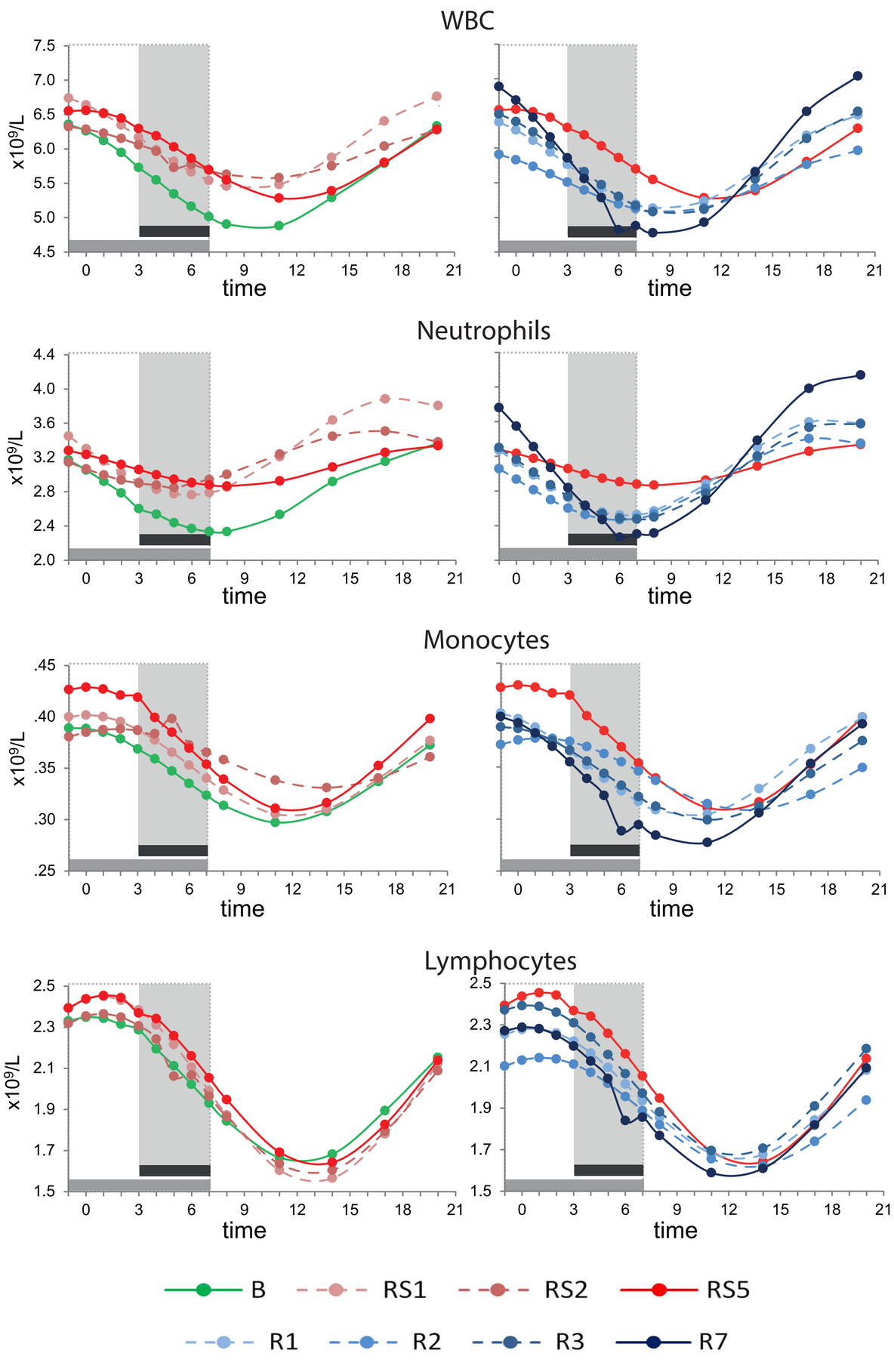
Results

Effect of sleep restriction and subsequent recovery on WBC subpopulation



Numbers of total WBC, neutrophils, monocytes and lymphocytes were increased over the days of sleep restriction. Numbers of monocytes and lymphocytes were reduced by subsequent recovery sleep. However, the number of total WBC and neutrophils did not change significantly over the days of sleep recovery.

Effect of sleep restriction and subsequent recovery on diurnal rhythms of WBC subpopulations



A flattening of the diurnal rhythms of total WBC and neutrophils and monocytes was observed over the days of sleep restriction. The inverse was seen during sleep recovery. However, the amplitude of diurnal variation of total WBC, neutrophils and monocytes were significantly higher at the end of the recovery period compared to baseline.

Conclusion

- **The present study shows for the first time the gradual increase of WBC subpopulations in the circulation during sustained sleep restriction, an effect associated with gradual alteration of the respective diurnal rhythms.**

- **Although recovery sleep seemed to restore most effects of restricting sleep, all numbers and diurnal patterns were not back to baseline, even after seven days of recovery sleep.**

- **Present findings are clinically relevant as they suggest that the recurrence or chronicity of periods of insufficient sleep might contribute to increase the risk to develop several diseases that are associated with immune alterations, such as cardiovascular diseases, type 2 diabetes or depression.**

Reference:
Lasselin J, Rehman J, Åkerstedt T, Lekander M, Axelsson J. *Effect of long-term sleep restriction and subsequent recovery sleep on the diurnal rhythms of white blood cell subpopulations*. Brain, Behavior and Immunity. In press

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E-mail info@stressforskning.su.se **Website** www.stressresearch.se

CONTACT
Julie Lasselin, Stress Research Institute, Stockholm, Sweden
E-mail julie.lasselin@su.se