

The Bi-Directional Relationship Between Sleep, Immunity and Infections

Article by **Lisa Costa Bir**

Naturopath and Educator



Sleep is a physiological process that is essential for well-being and imperative for immune health. Despite the importance of sleep, many Australians experience sleep disturbances; with sleep disorders estimated to affect approximately 33-45 per cent of the Australian adult population.¹

Although sleep is typically characterised by long periods of immobility, the immune system is highly active during this time, working to enhance immune defences through the promotion of innate and adaptive immunity. Unsurprisingly, host immunity to pathogens is greatly influenced by the lack of sleep. Interestingly however, this relationship is not one-sided.

An activated immune system that is responding to a pathogen influences sleep quality and quantity, highlighting the bi-directional relationship that exists between sleep and immunity.

The connection between immunity and sleep

Interleukin-6 (IL-6) is an important pleiotropic cytokine, that significantly increases in production during nocturnal hours, alongside an increase in REM sleep, highlighting its role as a putative 'sleep factor'.² IL-6 exerts specific immune activity via multiple factors not limited to its effects on T cell regulation and the promotion of macrophage phagocytic activities.³ Early night sleep deprivation as well as total sleep deprivation are associated with the delayed release of IL-6, suggesting immune suppressive effects of total lack of sleep while also emphasising the importance of sleep timing on immune function.

The process of sleep is instrumental in facilitating the movement of immune cells to specific lymphatic tissues. Circulating immune cells, including undifferentiated naïve T cells, peak early in the night and subsequently decline throughout the nocturnal hours where they then move out of circulation into lymphoid organs.⁴ Being awake in the early hours of the night impedes this process, increasing susceptibility to infection.

Sleep supports the consolidation phase of immunological memory formation. During slow wave

sleep, there is a transfer of antigenic information from antigen presenting cells to T cells, assisting the immune system to form a targeted immune response should it encounter a familiar antigen again.⁵

General recommendations around sleep quantity for optimal well-being and immune health suggest seven or more hours per night for healthy adults.⁶ Population studies however, demonstrate an increasing prevalence of adults sleeping less than 6 hours per night.⁷ This is hypothesised to be due to work and societal pressures (e.g., shift work and social jet lag where a person's social commitments interfere with their biological chronotype), increased night-time light exposure due to smart phone addiction and poor dietary choices, for example increased intake of alcohol and caffeine – both of which are known to impact sleep quality and duration.

Risks of sleep deprivation

The consistent lack of sleep is associated with an increase in pro-inflammatory cytokines receptors release, including TNF-alpha, and a decrease in both anti-inflammatory cytokines receptors and natural killer activity.⁸ It is therefore no surprise that the lack of sleep is associated with an increased risk of infection. Individuals with habitually short sleep duration (<5 hours) are at increased risk of respiratory tract infections compared to those maintaining 7-8 hours of sleep.⁹

Inadequate sleep may also influence viral reactivation, with a 1.23-fold increase in the reactivation of latent herpes zoster virus observed in individuals with a sleep disorder.¹⁰ Immunised people after four consecutive nights of sleep restricted to just 4 hours were found to have IgG antibody titres 50% lower than individuals who had slept adequately, demonstrating a reduction in vaccine efficacy in people experiencing sleep deprivation.¹¹

Risk of infection to sleep

While sleep clearly influences overall immune function, immunological challenges such as viral or bacterial infection can alter normal sleep patterns.

Infection is associated with dramatic alterations in sleep quality and quantity, namely greater time in slow sleep wave and consequently decreased REM sleep.¹² This is in part due to the direct action from the pathogen, for example the release of viral peptides potentially infecting the central nervous system, but also due to an adaptive homeostatic response utilised by the host to divert energy to the immune system to eliminate the infection.

Given the interconnectedness of sleep and circadian rhythms, it is also imperative to understand and modify circadian disruption to support immunity.

Sleep is an important modulator of immunity that can enhance immune defence, however, healthy sleep requires appropriate duration, quality, timing, and regularity.



Sleep Tip for better sleep

Water-based passive body heating e.g. a warm shower or bath before bedtime

Associated with both improved self-rated sleep quality and sleep efficiency.

When scheduled 1-2 h before bedtime for as little as 10 minutes lead to a significant shortening of sleep onset latency.

Core body temperature decline increasing blood perfusion to the palms and soles, augmenting distal-to-proximal skin temperature gradient to enhance body heat dissipation.¹³