

Training load, sleep and immune function in elite female gymnasts

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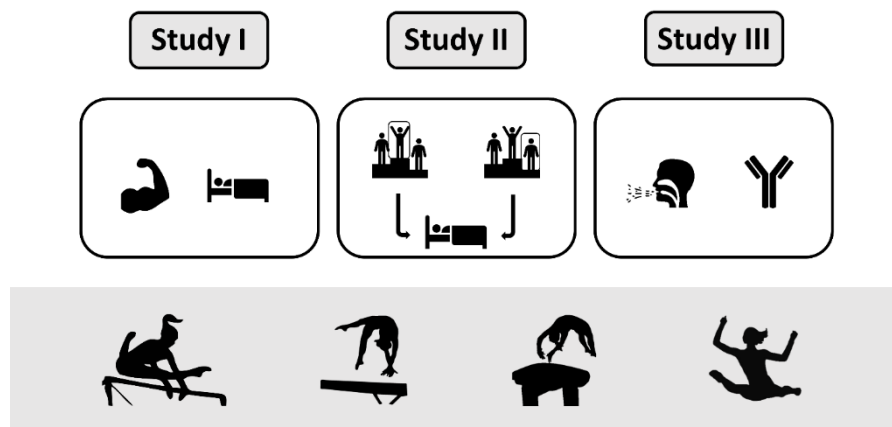
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Summary

Elite athletes train for a lifetime with the aim of achieving the best possible performance in their sport. Coaches, sport physiologists, dieticians, sports physicians,.... evaluate and monitor elite athletes to ensure they receive the most appropriate and specific guidance. A first component of this is determining the training load, which must be systematically increased and adjusted to the athlete's actual performance level. The optimal ratio between the imposed load and recovery will ultimately determine the functional performance capacity of the athlete. The most important recovery method, which regulates both the physical recovery and the processing of motor skills and emotional events, is sleep. Among elite athletes, little is known about the quantity and quality of sleep, so there are currently insufficient specific guidelines that can be drawn up. Besides training load and sleep, the athlete's immune function is a third factor that can strongly influence the training process of the athlete. After all, if the training process needs to be frequently interrupted by infections, it is impossible to attain a stable performance level. This may result in a lower level of performance. In addition, training load, sleep and immune function are interlinked, so they influence each other. We have studied these 3 parameters in a population of elite female gymnasts because their sport is known for its high training load from a young age, which must also be combined with school schedules. The figure below presents the 3 studies in this thesis.



In **Study I**, the training load and sleep (quantity and quality) of elite female gymnasts of different ages were quantified using subjective measurement methods (session Rate of Perceived Exertion and sleep diary). The training load of the younger gymnasts was lower than that of the older gymnasts. Moreover, the younger gymnasts slept better (= better sleep efficiency) and longer than the older gymnasts. Sleep quantity was related to training load, with higher training loads resulting in shorter sleep durations, possibly due to muscle soreness associated with strenuous training sessions, and longer sleep durations causing lower perceived training loads, presumably due to increased recovery and lower fatigue. In a subgroup participating in the World Championships, the better performing gymnasts showed lower perceived training loads and longer sleep durations.

In **Study II**, the sleep quantity and quality of 12 elite gymnasts was objectively evaluated by means of polysomnography and compared with the sleep of 10 sub-elite gymnasts. The elite gymnasts had a higher proportion of deep sleep compared to the sub-elite gymnasts. This sleep phase is essential for physical recovery as here, growth hormone release peaks. This ensures the recovery of tissues and muscles. The proportion of deep sleep was associated with training hours per week and not with fitness or training hours the day of the polysomnography. As the proportion of deep sleep decreases with age, this variable should also be considered for a correct evaluation of deep sleep.

In **Study III**, the immune function of elite gymnasts was monitored over the period of one year. Immunoglobulin A, measured weekly in the saliva, was used as a measure of the specific immune system, while symptoms of upper respiratory tract infections and fatigue were surveyed weekly. These parameters showed similar values as in other athletic populations, but immunoglobulin A fluctuated throughout the day and seasons. In addition, immunoglobulin A was associated with fatigue, so fatigue could be used as a surrogate to assess and monitor the functioning of the immune system. Also, age should be taken into account as the incidence of upper respiratory symptoms increased with age.

From our studies, we can conclude that artistic elite female gymnasts show no augmented risk of recurrent sleep disturbances and upper respiratory tract infections compared to other athlete populations although their TL is high. These parameters appear to be associated with their performance level, protecting the better (talented?) ones by an enhanced sleep architecture and immune-defence system. As such, identification of alterations in perceived TL, sleep and illness-associated fatigue is crucial to ensure the desired optimal performance. Based on the findings of this doctoral thesis, we can therefore recommend the monitoring of these three parameters in elite female gymnasts in the guidance towards optimal performance.

Curriculum Vitae – A1 Publications

Dumortier J, Mariman A, Boone J, Delesie L, Tobback E, Vogelaers D, Bourgois JG. Sleeping towards medals? The difference in sleep architecture between elite and non-elite gymnasts. *Submitted to International Journal of Sports Physiology and Performance 2020*

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Dumortier J, Mariman A, Boone J, Delesie L, Tobback E, Vogelaers D, Bourgois JG. Sleep, training load and performance in elite female gymnasts. *Eur J Sport Sci*. 2018;18(2):151-161. doi:10.1080/17461391.2017.1389992

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Celie BM, Boone J, **Dumortier J**, Derave W, De Backer T, Bourgois JG. Possible Influences on the Interpretation of Functional Domain (FD) Near-Infrared Spectroscopy (NIRS): An Explorative Study. *Appl Spectrosc*. 2016;70(2):363-371. doi:10.1177/0003702815620562

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