Time to wake up: Individualising the approach to sleep promotion interventions

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Hugh HK Fullagar[1,2] & Jonathan D Bartlett[3,4]

[1]Institute of Sport and Preventive Medicine,
Saarland University,
GEB, B.8.2, 66123,
Saarbrucken,
Germany

[2]Sport & Exercise Discipline Group, UTS: Health
Eton Road, Lindfield
University of Technology
Sydney, New South Wales
Australia, 2070

[3]Institute of Sport Exercise and Active Living,
Footscray Park
Ballarat Road
Victoria University
Melbourne, Victoria
Australia, 8001

[4]Western Bulldogs FC
Whitten Oval
Barkly Street, West Footscray
Victoria, Melbourne
Australia, 3210

Address for Correspondence:
Hugh HK Fullagar
Institute of Sport and Preventive Medicine, Saarland University, GEB, B.8.2, 66123,
Saarbrucken, Germany
Email: hugh.fullagar@uni-saarland.de

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Sleep is fundamental to normal physiological and cognitive function. Sleep promotion strategies have been used extensively in clinical settings as a treatment for various ailments (i.e. insomnia). However, sleep problems are prevalent outside these realms, with 56% of American, 31% of Western European and 29% of Japanese people suffering from sleep problems the previous year (1). The global public health concern over sleep has increased the demand for sleep promotion interventions but the efficacy of these strategies is unclear in otherwise healthy and athletic populations (2). One possibility is due to the presentation and analysis of grouped data, despite sleep naturally being a highly variable and inherent trait. Here we argue the case for (i) presenting sleep data at the individual level and (ii) individualising sleep promotion interventions.

Sleep variability challenges our understanding of sleep behaviour

Understanding a person's sleep behaviour is beset with many challenges as the quantity, quality and the overall composition of sleep varies considerably between individuals and occupations (3). This variation is attributed to a vast array of physiological and cultural differences. Lifestyle choices and inter-individual differences in the requirement for sleep both influence the choice of human sleep volume (3). In addition, choosing how long to sleep is likely affected by the ability of an individual's willingness to function under different levels of sleep debt. There are inter-individual differences in physiological and cognitive responses to sleep loss (4), similar to responses regarding exercise, stress management, noise, sleep timing, daytime napping and consumption of caffeine, nicotine, alcohol (2). These collective issues make both the interpretation of generic sleep recommendations for normal populations and athletes (5) and outcomes arising from intervention studies inherently difficult, especially at the individual level. Thus, it may be prudent for future research to consider incorporating the presentation of sleep data encompassing individual responses, in addition to group-means. Along with mixed-linear-model statistical approaches (using subject identity as a random effect), this could help to separate within-subject variability from the interaction of the 'individual response' (6).

Large-scale observational studies in normal and unhealthy populations govern our current knowledge of sleep behaviours and determine sleep recommendations. In the 1960s average sleep duration was ~8 h, whereas now it is approximately ~6.5 h (5). Given the potential benefits

of sleep enhancement on hormonal and metabolic function (7), we propose (along with others (2)) the need for additional experimental interventions within normal social contexts for 'healthy' individuals. There is a need for experimental investigations examining ways to improve sleep in populations that experience occupational sleep loss i.e. shift workers, pilots, and possibly athletes. In addition, it may be advantageous to tailor intervention strategies to the context of the specific governor of an individual's sleep behaviour. For instance, are there different sleep hygiene strategies between populations? Owing to the development in e-technology (8) and smart phones, fitness tracking technology and built-in accelerometers, studies incorporating the measurement of sleep in everyday life is becoming increasingly possible, therefore, enhancing our approach to this global issue.

Comment [KK1]:

The association between exercise and sleep

The interaction between exercise and sleep has long received attention, most recently for athletes (4). Indeed, reports of impaired endocrine function with sleep loss, such as increases in catabolic and decreases in anabolic hormones, have led to the assumption that muscle protein synthesis and therefore, training adaptation are impaired following exercise and reduced sleep (9). Since protein turnover is a major component of the adaptive response and the primary modulator for maintaining functional mitochondria, this is important for athletic performance and/or recovery. However, there is an abundance of between- and within-subject variability in the results which arise from sleep intervention studies in elite athletes (4, 6). Thus, it would seem appropriate to present these results with relevance to the possible differences in sleep behaviour between individuals (i.e. sleep chronotype). Further studies which assess the effect of interventions (i.e. sleep hygiene, types of training) on sleep parameters between individuals require further examination. It is also of major interest to many practitioners whether a change in sleep parameters (either positive or negative) affects the recovery or performance continuum.

In summary, we argue that researchers should present sleep data at the individual level and that there is a need for further individualised sleep promotion interventions. Future work should focus on interventions that allow for an understanding of the development of sleep behaviours in normal individuals. This is needed before we can understand sleep in athletes. Where possible,

studies should aim take place in a variety of conventional social contexts and be conducted over prolonged periods.

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