

Love

## Outcome

Grade	Synthesis
A	S1 Insightful synthesis of knowledge, skills, and ideas to produce a resolution to the research question. †
	S2 Insightful and thorough substantiation of key findings relevant to the research outcome. †
	S3 Clear and coherent expression of ideas. †
B	S1 Considered synthesis of knowledge, skills, and ideas to produce a resolution to the research question.
	S2 Substantiation of most key findings relevant to the research outcome.
	S3 Mostly clear and coherent expression of ideas.
C	S1 Satisfactory synthesis of knowledge, skills, and ideas to produce a resolution to the research question.
	S2 Substantiation of some key findings relevant to the research outcome.
	S3 Generally clear expression of ideas.
D	S1 Basic use of information and ideas to produce a resolution to the research question.
	S2 Basic explanation of ideas related to the research outcome.
	S3 Basic expression of ideas.
E	S1 Attempted use of an idea to produce a resolution to the research question.
	S2 Limited explanation of an idea or an aspect of the research outcome.
	S3 Attempted expression of ideas.

Comment:

A+

THIS IS AN OUTSTANDING PIECE OF RESEARCH LOVE! YOUR ABILITY TO SYNTHESISE ALL YOUR RESEARCH INTO A SUCCINT, DENSE & COHESIVE REPORT IS EXCELLENT.

YOUR SUBSTANTIATION IS EXTENSIVE & ACCURATE AS WELL AS SHOWING A LOT OF INSIGHT THROUGH YOUR OWN EXPERIMENTS.

GREAT EFFORT & WELL DONE!

# Research Project Outcome

Word Count -1764

## ***How does the quantity and quality of sleep a sprinter obtains affect their mental and physical performance and how can this information be used to best enhance performance?***

The research conducted focussed on how a sprinter's *mental* and *physical performance* is affected by the *quantity* and *quality* of their sleep and how they can apply this information to *best enhance* their performance. The key research areas included how *quantity* of sleep affects *mental* and *physical performance* and how *quality* of sleep affects *mental* and *physical performance*. In addition, it was considered how sprinters can use information about circadian rhythms, sleep hygiene, napping and sleep extension to get a better *quantity* and *quality* of sleep to *best enhance* their performance.

## **How does the quantity of sleep a sprinter obtains affect their mental performance?**

*Mental* aspects of performance affected by the *quantity* of sleep a sprinter obtains include:

- Cognition<sup>1</sup>, in particular strategic thinking<sup>2</sup>, decision making<sup>3</sup> and learning<sup>4</sup>
- Attention<sup>5</sup> and concentration<sup>6</sup>
- Stress levels<sup>7</sup>
- Reaction time<sup>8</sup>
- Motivation<sup>9</sup> and attitude<sup>10</sup>
- Perception of effort<sup>11</sup>
- Mood<sup>12</sup>

It is, however, up to the athlete whether they allow their mood, stress levels and attitude be affected and hence affect their *mental performance*<sup>13</sup>. Furthermore, sleep deprivation causes humans, particularly

<sup>1</sup> Samuels, C. 2008, 'Sleep, Recovery, and Performance: The New Frontier in High-Performance Athletics', *Neurologic Clinics*, vol. 26, no. 1, pp. 169-180, <http://www.pgedf.ufpr.br/Referencias08/Samuels2008%20FL.pdf>, accessed 25 March 2015.

<sup>2</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>3</sup> Sargent, C. Halson, S. Roach, G. 2014, 'Sleep or swim? Early-morning training severely restricts the amount of sleep obtained by elite swimmers', *European Journal of Sport Science*, vol. 14, no. 1, pp. 310-315, [http://www.tandfonline.com/doi/full/10.1080/17461391.2012.696711#\\_i4](http://www.tandfonline.com/doi/full/10.1080/17461391.2012.696711#_i4), accessed 28 March 2015.

<sup>4</sup> Halson, S. 2014, 'Sleep in Elite Athletes and Nutritional Interventions to Enhance Sleep', *Sports Medicine*, vol. 44, no.1, pp. 13-23, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4008810/>, accessed 5 May 2015.

<sup>5</sup> Fatigue Science, 2013, *Sleep School: The basics of sleep*, <http://fatiguescience.com/2013/08/22/infographic-the-basics-of-sleep/>, accessed 5 February 2015.

<sup>6</sup> O'Mara, K. 2014, *Sleep In – It Will Make You Faster*, [http://running.competitor.com/2014/02/training/sleep-in-it-will-make-you-faster\\_65949](http://running.competitor.com/2014/02/training/sleep-in-it-will-make-you-faster_65949), accessed 26 February 2015.

<sup>7</sup> Harvard Health Publications, 2007, *Repaying Your Sleep Debt*, <http://www.health.harvard.edu/fhg/updates/Repaying-your-sleep-debt.shtml>, accessed 5 February 2015.

<sup>8</sup> Taheri, M. Arabameri, E. 2012, 'The Effect of Sleep Deprivation on Choice Reaction Time and Anaerobic Power of College Student Athletes', *Asian Journal of Sports Medicine*, vol. 3, no. 1, pp. 15-20, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3307962/>, accessed 30 March 2015.

<sup>9</sup> O'Mara, K. 2014, *Sleep In – It Will Make You Faster*, [http://running.competitor.com/2014/02/training/sleep-in-it-will-make-you-faster\\_65949](http://running.competitor.com/2014/02/training/sleep-in-it-will-make-you-faster_65949), accessed 26 February 2015.

<sup>10</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>11</sup> Davis, J. 2010, *Running on No Sleep: How it Effects Performance on Race Day and in Training*, <http://runnersconnect.net/running-training-articles/running-on-no-sleep/>, accessed 25 March 2015.

<sup>12</sup> Smart, B. 2015, *An Allergist/Immunologist's Guide to Living Well*, <http://drbriansmart.com/the-effect-of-sleep-deprivation-on-athletic-performance/>, accessed 28 March 2015.

sprinters, to become less strategical and more emotional<sup>14</sup>. *Mental performance* is particularly impacted by the *quantity* of sleep obtained as the brain and nervous system are the parts of the body that require sleep the most<sup>15</sup>. The significant impact of sleep deprivation on *mental performance* can be seen by the fact that 24 hours without sleep, or a week of sleeping four or five hours a night, leads to an impairment equivalent to a blood alcohol level of .1 per cent<sup>16</sup>. Unfortunately, as a sprinter becomes increasingly sleep deprived, the less capable they become of recognising it<sup>17</sup>. Consequently, this can cause performance to become increasingly impaired. However, one or two bad night's sleep before a competition will not negatively harm a sprinter's *mental performance*<sup>18 19</sup> provided they aren't worried about it<sup>20</sup>. In summary, the *quantity* of sleep a sprinter obtains has a substantial effect on their ability to *perform* at their *best mentally*.

SI A standard

### How does the quantity of sleep a sprinter obtains affect their physical performance?

In comparison to their *mental performance*, a sprinter's *physical performance* is less affected by the *quantity* of sleep they obtain<sup>21</sup>. However, the *quantity* of sleep a sprinter obtains does have an effect on various facets of their *physical performance*. These include:

- Strength and bone density<sup>22</sup>
- Recovery time<sup>23</sup>
- The likelihood of sustaining an injury<sup>24</sup>
- Glucose metabolism - which will affect energy levels<sup>25</sup>
- Perceived effort and pain<sup>26</sup>
- Immune function<sup>27</sup>

<sup>13</sup> Surveys conducted at ASA State Championships from 27/2/2015 to 1/3/2015.

<sup>14</sup> Elliot, D. 2014, *The Doctor Who Coaches Athletes on Sleep*, <http://www.theatlantic.com/health/archive/2014/04/for-better-performance-athletes-need-sleep/361042/3/>, accessed 5 February 2015.

<sup>15</sup> Davis, J. 2010, *Running on No Sleep: How it Effects Performance on Race Day and in Training*, <http://runnersconnect.net/running-training-articles/running-on-no-sleep/>, accessed 25 March 2015.

<sup>16</sup> Elliot, D. 2014, *The Doctor Who Coaches Athletes on Sleep*, <http://www.theatlantic.com/health/archive/2014/04/for-better-performance-athletes-need-sleep/361042/3/>, accessed 5 February 2015.

<sup>17</sup> Harvard Health Publications, 2007, *Repaying Your Sleep Debt*, <http://www.health.harvard.edu/fhg/updates/Repaying-your-sleep-debt.shtml>, accessed 5 February 2015.

<sup>18</sup> Davis, J. 2010, *Running on No Sleep: How it Effects Performance on Race Day and in Training*, <http://runnersconnect.net/running-training-articles/running-on-no-sleep/>, accessed 25 March 2015.

<sup>19</sup> O'Mara, K. 2014, *Sleep In – It Will Make You Faster*, [http://running.competitor.com/2014/02/training/sleep-in-it-will-make-you-faster\\_65949](http://running.competitor.com/2014/02/training/sleep-in-it-will-make-you-faster_65949), accessed 26 February 2015.

<sup>20</sup> Austin, M. N.D., *Strategies for Quality Sleep*, [http://www.ausport.gov.au/sportscoachmag/psychology2/strategies\\_for\\_quality\\_sleep](http://www.ausport.gov.au/sportscoachmag/psychology2/strategies_for_quality_sleep), accessed 19 February 2015.

<sup>21</sup> Miller, K, 2015, Interviewed by Luke Nicholls, Adelaide, 5 March.

<sup>22</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>23</sup> Fatigue Science, 2014, *Athlete monitoring in the NBA*, <http://fatiguescience.com/2014/10/23/espn-magazine-athlete-monitoring-nba/>, accessed 5 February 2015.

<sup>24</sup> Fatigue Science, 2013, *Unlock the Competitive Advantage of Sleep*, <http://fatiguescience.com/solutions/sports-performance-enhancements/>, accessed 5 February 2015.

<sup>25</sup> Sargent, C. Halson, S. Roach, G. 2014, 'Sleep or swim? Early-morning training severely restricts the amount of sleep obtained by elite swimmers', *European Journal of Sport Science*, vol. 14, no. 1, pp. 310-315, [http://www.tandfonline.com/doi/full/10.1080/17461391.2012.696711#\\_i4](http://www.tandfonline.com/doi/full/10.1080/17461391.2012.696711#_i4), accessed 28 March 2015.

<sup>26</sup> Fatigue Science, 2013, *Sleep to be an all-star: Why athletes should make sleep a priority in their daily training (Infographic)*, <http://fatiguescience.com/2013/09/03/infographic-why-athletes-should-make-sleep-a-priority-in-their-daily-training/>, accessed 5 February 2015.



- Endocrine system function<sup>28</sup> - which affects delivery of adrenaline and testosterone<sup>29</sup>
- Lipolysis, instead causing muscle atrophy<sup>30</sup>.
- Growth hormone production in the pituitary gland - which will lead to a reduction in the effectiveness of hypertrophy from training<sup>31</sup>. ✓✓
- Appetite<sup>32</sup>.

Fortunately for sprinters, maximal exercise, such as sprinting, is less affected by sleep deprivation than sub-maximal exercise, such as endurance running<sup>33</sup>. Furthermore, a sprinter has to be awake for 30 hours straight for their sprinting performance to be negatively affected<sup>34</sup>. However, muscle fatigue accumulates due to sleep loss, so the more a sprinter becomes sleep deprived, the greater the affect it will have on their *physical performance*<sup>35</sup>. Moreover, *physical performance* is more affected by sleep loss when the sprinter has to do repeated exercise<sup>36</sup>. This is particularly important to sprinters during competitions when they may have to compete on multiple occasions throughout the day<sup>37</sup>. However, *physical performance* is unlikely to be affected by one sleepless night<sup>38</sup>. Hence it has been shown that the *quantity* of sleep a sprinter obtains has a considerable effect on their ability to *perform* at their *best physically*. S I A studied.

## How does the quality of sleep a sprinter obtains affect their mental and physical performance?

Poor *quality* sleep has a negative effect on:<sup>39</sup>

- Regrowth of tissue - which is important in benefiting from training

<sup>27</sup> Samuels, C. 2008, 'Sleep, Recovery, and Performance: The New Frontier in High-Performance Athletics', *Neurologic Clinics*, vol. 26, no. 1, pp. 169-180, <http://www.pgedf.ufpr.br/Referencias08/Samuels2008%20FL.pdf>, accessed 25 March 2015.

<sup>28</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>29</sup> Samuels, C. 2008, 'Sleep, Recovery, and Performance: The New Frontier in High-Performance Athletics', *Neurologic Clinics*, vol. 26, no. 1, pp. 169-180, <http://www.pgedf.ufpr.br/Referencias08/Samuels2008%20FL.pdf>, accessed 25 March 2015.

<sup>30</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>31</sup> Fatigue Science, 2014, *Athlete monitoring in the NBA*, <http://fatiguescience.com/2014/10/23/espn-magazine-athlete-monitoring-nba/>, accessed 5 February 2015.

<sup>32</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>33</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>34</sup> Souissi, N. Sesboue, B. Gauthier, A. Larue, J. Davenne, D. 2003, 'Effects of one night's sleep deprivation on anaerobic performance the following day', *European Journal of Applied Physiology*, vol. 89, no. 3-4, pp. 359-366, [http://www.researchgate.net/publication/10768705\\_Effects\\_of\\_one\\_night's\\_sleep\\_deprivation\\_on\\_anaerobic\\_performance\\_the\\_following\\_day](http://www.researchgate.net/publication/10768705_Effects_of_one_night's_sleep_deprivation_on_anaerobic_performance_the_following_day), accessed 30 March 2015.

<sup>35</sup> Smart, B. 2015, *An Allergist/Immunologist's Guide to Living Well*, <http://drbriansmart.com/the-effect-of-sleep-deprivation-on-athletic-performance/>, accessed 28 March 2015.

<sup>36</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>37</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>38</sup> Quinn, E. 2014, *Do Athletes Need Extra Sleep*,

<http://sportsmedicine.about.com/od/anatomyandphysiology/a/Athletes-Sleep.htm>, accessed 5 February 2015.

<sup>39</sup> Austin, M. N.D., *Strategies for Quality Sleep*,

[http://www.ausport.gov.au/sportscoachmag/psychology2/strategies\\_for\\_quality\\_sleep](http://www.ausport.gov.au/sportscoachmag/psychology2/strategies_for_quality_sleep), accessed 19 February 2015.

- Immune function
- Hormonal function
- Fatigue
- Tendency to injury
- Heart function

There are many different stages of sleep and each has its own function, this is what makes *quality* sleep so vital to performance<sup>40</sup>. For example, REM (Rapid Eye Movement) sleep is important in brain regeneration and controlling of emotions<sup>41</sup>, which affect *mental performance*. On the other hand, non-REM sleep plays a role in restoring the nervous system and conserving energy<sup>42</sup>, which will have an effect on both *mental* and *physical performance*. During slow-wave sleep, which occurs in stages 3 and 4 of non-REM sleep, the pituitary gland releases growth hormone which leads to tissue growth and repair<sup>43</sup>, this will have an effect on *physical performance*. In addition, due to increased levels of anxiety, hydration programs, muscle soreness and consumption of caffeine and alcohol close to bed, sprinters have a greater sleep latency than the average human<sup>44</sup>. In brief, the *quality* of sleep a sprinter obtains has a sizeable effect on their aptitude to *perform at their best both physically and mentally*.

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## How can a sprinter use their knowledge about getting a good quality and quantity of sleep to best enhance their mental and physical performance?

How the *quantity* and *quality* of sleep a sprinter obtains affects their *mental* and *physical performance* has been shown to be substantial. Hence, individual sprinters should explore how circadian rhythms, sleep hygiene, napping and sleep extension affect their *quantity* and *quality* of sleep and how they can use this knowledge to *best enhance* their *performance*.

Circadian rhythms can have a major effect on *mental* and *physical performance*<sup>45</sup> as *quantity* and *quality* of sleep are affected when the circadian preference does not match the sleep schedule<sup>46</sup>. Humans are naturally programmed to sleep from 12 am to 6am and from 2pm to 4pm<sup>47</sup>, thus sleep will be most productive in producing optimal performance when sprinters sleep during these time periods. However, during

<sup>40</sup> Austin, M. N.D., *Strategies for Quality Sleep*, [http://www.ausport.gov.au/sportscoachmag/psychology2/strategies\\_for\\_quality\\_sleep](http://www.ausport.gov.au/sportscoachmag/psychology2/strategies_for_quality_sleep), accessed 19 February 2015.

<sup>41</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>42</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>43</sup> Harvard Health Publications, 2007, *Repaying Your Sleep Debt*, <http://www.health.harvard.edu/fhg/updates/Repaying-your-sleep-debt.shtml>, accessed 5 February 2015.

<sup>44</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>45</sup> Reilly, T Atkinson, G & Waterhouse, J, 1997, *Biological Rhythms and Exercise*, Oxford University Press Inc., New York, pp. 13.

<sup>46</sup> Samuels, C. 2008, 'Sleep, Recovery, and Performance: The New Frontier in High-Performance Athletics', *Neurologic Clinics*, vol. 26, no. 1, pp. 169-180, <http://www.pgdef.ufpr.br/Referencias08/Samuels2008%20FL.pdf>, accessed 25 March 2015.

<sup>47</sup> Fatigue Science, 2013, *How Napping Can Increase Your Alertness and Performance*, <http://fatiguescience.com/2013/07/25/infographic-how-napping-can-increase-your-alertness-and-performance/>, accessed 5 February 2015.

adolescence, the sleep phase occurs later during the 24 hour cycle<sup>48</sup>, this should be taken into account by teenage sprinters when they are trying to align their sleep schedule with their circadian preferences. Most sprinters perform at their worst in the morning<sup>49</sup>. However, training sessions are often held in the early morning. Early morning training sessions also restrict the *quantity* of sleep a sprinter is able to obtain as their circadian rhythms will not allow them to sleep in the early evening<sup>50</sup>. However, circadian rhythms can be altered to allow sprinters to be able to train effectively in the early morning by using a seasonal affective disorder light<sup>51</sup>. Thus in the lead up to competitions, sprinters should try and keep their sleep schedule as similar to their sleep schedule during the competition as possible<sup>52</sup>. Sprinters should also try to keep their sleep patterns as consistent as possible at all times<sup>53</sup>. To review, sprinters should try to align their sleep schedule with their circadian rhythms to raise their *quantity* and *quality* of sleep to lead to the *best possible enhancement* in their *performance*.

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Good sleep hygiene can also lead to notable improvement in sprinting performance<sup>54</sup>. However, many athletes, including sprinters, do not have strategies or methods to overcome sleep problems<sup>55</sup>. The solution may be simple though: increased education<sup>56</sup>. There are 4 key steps to sprinters overcoming pre-competition sleep problems<sup>57</sup>:

1. Identify the problem.
2. Identify the cause of the problem.
3. Identify how the problem is affecting performance.
4. Identify how the problem can be overcome.

<sup>48</sup> Samuels, C. 2008, 'Sleep, Recovery, and Performance: The New Frontier in High-Performance Athletics', *Neurologic Clinics*, vol. 26, no. 1, pp. 169-180, <http://www.pgedf.ufpr.br/Referencias08/Samuels2008%20FL.pdf>, accessed 25 March 2015.

<sup>49</sup> Kolata, G. 2015, *For Athletes, the Time of an Event Can Affect Performance*, [http://well.blogs.nytimes.com/2015/01/29/for-athletes-the-time-of-an-event-can-affect-performance/?\\_r=0](http://well.blogs.nytimes.com/2015/01/29/for-athletes-the-time-of-an-event-can-affect-performance/?_r=0), accessed 12 May 2015.

<sup>50</sup> Sargent, C. Halson, S. Roach, G. 2014, 'Sleep or swim? Early-morning training severely restricts the amount of sleep obtained by elite swimmers', *European Journal of Sport Science*, vol. 14, no. 1, pp. 310-315, [http://www.tandfonline.com/doi/full/10.1080/17461391.2012.696711#\\_i4](http://www.tandfonline.com/doi/full/10.1080/17461391.2012.696711#_i4), accessed 28 March 2015.

<sup>51</sup> Samuels, C. 2008, 'Sleep, Recovery, and Performance: The New Frontier in High-Performance Athletics', *Neurologic Clinics*, vol. 26, no. 1, pp. 169-180, <http://www.pgedf.ufpr.br/Referencias08/Samuels2008%20FL.pdf>, accessed 25 March 2015.

<sup>52</sup> Miller, K, 2015, Interviewed by Luke Nicholls, Adelaide, 5 March.

<sup>53</sup> Fatigue Science, 2013, Sleep School: Tips for Athletes to Get Their Rest Before a Big Game, <http://fatiguescience.com/2013/12/07/sleep-school-tips-for-athletes-to-get-their-rest-before-a-big-game/>, accessed 28 March 2015.

<sup>54</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>55</sup> Mah, C. Mah, K. Kezirian, E. Dement, W. 2011, 'The Effects of Sleep Extension on the Athletic Performance of Collegiate Basketball Players', *SLEEP*, vol. 34, no. 7, pp. 943-950, <http://www.journalsleep.org/ViewAbstract.aspx?pid=28194>, accessed 28 March 2015.

<sup>56</sup> Juliff, L. Halson, S Peiffer, J. 2014, 'Understanding sleep disturbance in athletes prior to important competitions', *Journal of Science and Medicine in Sport*, [http://www.jsams.org/article/S1440-2440\(14\)00035-8/abstract](http://www.jsams.org/article/S1440-2440(14)00035-8/abstract), accessed 27 March 2015.

<sup>57</sup> Juliff, L. Halson, S Peiffer, J. 2014, 'Understanding sleep disturbance in athletes prior to important competitions', *Journal of Science and Medicine in Sport*, [http://www.jsams.org/article/S1440-2440\(14\)00035-8/abstract](http://www.jsams.org/article/S1440-2440(14)00035-8/abstract), accessed 27 March 2015.

Good sleep hygiene can provide long-term solutions to sleep problems<sup>58</sup>. Good sleep hygiene includes:

- Keeping bedrooms cool, dark and quiet<sup>59</sup>.
- Going to bed and waking up at a similar time each day<sup>60</sup>.
- Not watching TV or using a computer in bed<sup>61</sup>.
- Not watching the clock<sup>62</sup>.
- Avoiding caffeine for 4-5 hours before bed<sup>63</sup>.
- Not consuming excessive food or drink before bed, particularly alcohol<sup>64</sup>.
- Napping for a maximum duration of one hour and not too close to bedtime<sup>65</sup>.
- Not exercising too late in the day<sup>66</sup>.
- Relaxing before bed<sup>67</sup>. This includes reading<sup>68</sup>, stretching and breathing exercises<sup>69</sup>.
- Taking a hot bath<sup>70</sup> around an hour before bed<sup>71</sup>.
- Only using bedrooms for sleeping in<sup>72</sup>.
- Staying calm if you are having trouble sleeping or are waking up regularly<sup>73</sup>.
- Only trying to sleep when you feel sleepy<sup>74</sup>.

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<sup>58</sup> Centre for Clinical Interventions, 2007, *Sleep Hygiene*, <http://www.cci.health.wa.gov.au/docs/Info-sleep%20hygiene.pdf>, accessed 5 May 2015.

<sup>59</sup> Hatfield, H. N.D., *How to Sleep Like an Olympic Athlete*, <http://www.webmd.com/sleep-disorders/features/sleep-like-an-olympian>, accessed 12 May 2015.

<sup>60</sup> Mah, C. Mah, K. Kezirian, E. Dement, W. 2011, 'The Effects of Sleep Extension on the Athletic Performance of Collegiate Basketball Players', *SLEEP*, vol. 34, no. 7, pp. 943-950, <http://www.journalsleep.org/ViewAbstract.aspx?pid=28194>, accessed 28 March 2015.

<sup>61</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>62</sup> Centre for Clinical Interventions, 2007, *Sleep Hygiene*, <http://www.cci.health.wa.gov.au/docs/Info-sleep%20hygiene.pdf>, accessed 5 May 2015.

<sup>63</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>64</sup> Surveys conducted at ASA State Championships from 27/2/2015 to 1/3/2015.

<sup>65</sup> Fatigue Science, 2013, *Sleep School: The basics of sleep*, <http://fatiguescience.com/2013/08/22/infographic-the-basics-of-sleep/>, accessed 5 February 2015.

<sup>66</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>67</sup> Fatigue Science, 2013, *Sleep School: The basics of sleep*, <http://fatiguescience.com/2013/08/22/infographic-the-basics-of-sleep/>, accessed 5 February 2015.

<sup>68</sup> Juliff, L. Halson, S Peiffer, J. 2014, 'Understanding sleep disturbance in athletes prior to important competitions', *Journal of Science and Medicine in Sport*, [http://www.jsams.org/article/S1440-2440\(14\)00035-8/abstract](http://www.jsams.org/article/S1440-2440(14)00035-8/abstract), accessed 27 March 2015.

<sup>69</sup> Surveys conducted at ASA State Championships from 27/2/2015 to 1/3/2015.

<sup>70</sup> Fatigue Science, 2013, *Sleep School: The basics of sleep*, <http://fatiguescience.com/2013/08/22/infographic-the-basics-of-sleep/>, accessed 5 February 2015.

<sup>71</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>72</sup> Centre for Clinical Interventions, 2007, *Sleep Hygiene*, <http://www.cci.health.wa.gov.au/docs/Info-sleep%20hygiene.pdf>, accessed 5 May 2015.

<sup>73</sup> Fatigue Science, 2013, *Sleep School: Tips for Athletes to Get Their Rest Before a Big Game*, <http://fatiguescience.com/2013/12/07/sleep-school-tips-for-athletes-to-get-their-rest-before-a-big-game/>, accessed 28 March 2015.

<sup>74</sup> Centre for Clinical Interventions, 2007, *Sleep Hygiene*, <http://www.cci.health.wa.gov.au/docs/Info-sleep%20hygiene.pdf>, accessed 5 May 2015.

Young sprinters in particular can struggle to get a good sleep during competitions as they share group accommodation. Due to this, they should have practice runs at group accommodation before the competition to get rid of the novelty factor and to practice responsible behaviour<sup>75</sup>. Sprinters in general need to be disciplined<sup>76</sup> and focussed on the competition<sup>77</sup>. To sum up, sprinters should try to maintain good sleep hygiene to increase their *quantity* and *quality* of sleep to lead to the *best possible enhancement* in their *performance*.

Napping and sleep extension can both contribute to better sprinting performance. A 20-30 minute nap can improve alertness<sup>78</sup> by 100 per cent<sup>79</sup> while a 60 minute nap can increase alertness for up to 10 hours<sup>80</sup>. In addition, napping can be beneficial in improving sprint and reaction times<sup>81</sup> as well as cognition and concentration for sleep deprived sprinters<sup>82</sup>. Furthermore, napping can be particularly beneficial to sprinters who have early morning training sessions<sup>83</sup>. Also, increasing daily sleep *quantity* to over 10 hours leads to less daytime sleepiness and fatigue, faster sprint and reaction times, improved mood and better health<sup>84</sup>. As can be seen from the Figure 1, REM sleep increases the longer a sprinter sleeps. This means that a greater *quantity* of sleep will have a greater benefit to the *mental performance* of a sprinter, as *mental* functions are restored during REM sleep. Sprinters should also try to quickly recover sleep debt, and once it is paid off,

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<sup>75</sup> Miller, K, 2015, Interviewed by Luke Nicholls, Adelaide, 5 March.

<sup>76</sup> Surveys conducted at ASA State Championships from 27/2/2015 to 1/3/2015.

<sup>77</sup> Miller, K, 2015, Interviewed by Luke Nicholls, Adelaide, 5 March.

<sup>78</sup> Fatigue Science, 2013, Sleep School: Tips for Athletes to Get Their Rest Before a Big Game, <http://fatiguescience.com/2013/12/07/sleep-school-tips-for-athletes-to-get-their-rest-before-a-big-game/>, accessed 28 March 2015.

<sup>79</sup> Fatigue Science, 2013, *Sleep to be an all-star: Why athletes should make sleep a priority in their daily training (Infographic)*, <http://fatiguescience.com/2013/09/03/infographic-why-athletes-should-make-sleep-a-priority-in-their-daily-training/>, accessed 5 February 2015.

<sup>80</sup> Fatigue Science, 2013, *How Napping Can Increase Your Alertness and Performance*, <http://fatiguescience.com/2013/07/25/infographic-how-napping-can-increase-your-alertness-and-performance/>, accessed 5 February 2015.

<sup>81</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.

<sup>82</sup> Mah, C. Mah, K. Kezirian, E. Dement, W. 2011, 'The Effects of Sleep Extension on the Athletic Performance of Collegiate Basketball Players', *SLEEP*, vol. 34, no. 7, pp. 943-950, <http://www.journalsleep.org/ViewAbstract.aspx?pid=28194>, accessed 28 March 2015.

<sup>83</sup> Halson, S. 2014, *SSE #113: Sleep and the Elite Athlete*, <http://www.gssiweb.org/Article/sse-113-sleep-and-the-elite-athlete>, accessed 5 May 2015.

<sup>84</sup> Potter, G. 2013, *Sleep Strategies for Strength, Speed and Size*, <http://www.elitefts.com/education/training/sleep-strategies-for-strength-speed-and-size/>, accessed 5 May 2015.



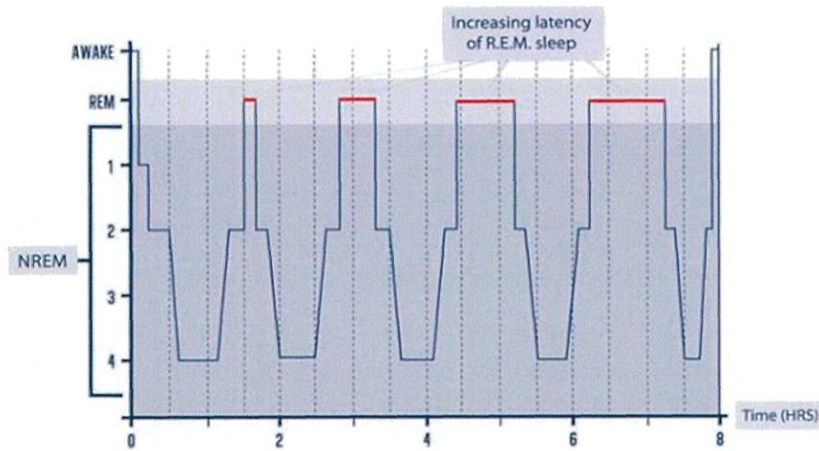


Figure 1. Phases of Sleep<sup>85</sup>

stick to disciplined sleep routines<sup>86</sup>. Hence, sprinters should strive to nap and extend their daily *quantity* of sleep to *best enhance* their *mental* and *physical performance*.

### Conclusion

The means by which the *quantity* and *quality* of sleep effects sprinters *physical* and *mental performance* was discovered through a comprehensive collection and meticulous analysis of many primary and secondary sources. In conclusion, sprinters should utilise strict sleep hygiene, napping and sleep extension while aligning their sleep schedule with their circadian preferences to improve their *quantity* and *quality* of sleep. This will lead to a positive effect on their immune function, endocrine function, cognition, concentration, stress levels, motivation, perception of effort, mood, metabolism, recovery rate, prevalence to injury, energy levels and hormonal function. Thus allowing them to *best enhance* their *mental* and *physical performance*.

<sup>85</sup> Fatigue Science, 2013, *Sleep School: The basics of sleep*, <http://fatiguescience.com/2013/08/22/infographic-the-basics-of-sleep/>, accessed 5 February 2015.

<sup>86</sup> Harvard Health Publications, 2007, *Repaying Your Sleep Debt*, <http://www.health.harvard.edu/fhg/updates/Repaying-your-sleep-debt.shtml>, accessed 5 February 2015.

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