Live High, Train Low

How does combined exposure to sleeping in a hyperbaric chamber and low-altitude training impact physiological adaptations and performance in runners?

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Contents

Live High Train Low

Abstract

The theory of training at altitude will increase the ability of the performance of an athlete. By being at 'Altitude' The purpose of this study is to contribute to the understanding of the 'sleep high, train low' which is in opposition to the usual 'train high, sleep low'. This study is based on an adolescent male athlete (17 years old) over a seven-month process in conjunction with medical professionals and coach. By sleeping at an altitude where the body is at rest, where it's able to manage and deal with the reduction of oxygen around the body without the stress of also training, the human body should have a higher chance of adapting to the altitude. The test showed that increase in altitude whilst sleeping requires the body to generate more Haemoglobin and red blood cells, which allows an athlete's body to improve aerobic respiration causing a 1-kilometre time to decrease. As the respiratory rate and circulatory system will be more efficient causing the Muscular respiration (transfer of oxygen and Carbon dioxide in the muscle) to be more efficient allowing larger amounts of ATP/CP, Lactate to be used whilst training/competing.

Scientific Question

"How does combined exposure to sleeping in a hyperbaric chamber and low-altitude training impact physiological adaptations and performance in runners?"

Literature review

History of the use of altitude to improve performance.

For over a decade, the live high-train low (LHTL) approach, pioneered by Levine and Stray-Gundersen, has been embraced by elite endurance athletes as a proven strategy. This method revolves around the concept that athletes can reside at moderate altitudes to stimulate desirable physiological adaptations, such as enhanced red cell volume (RCV) and haemoglobin mass (Hbmass), while conducting their training sessions at lower altitudes to counterbalance the potential drawbacks of reduced training intensity experienced at moderate elevations (Shona L Halson, 2017). This well-established approach has continuously garnered attention and widespread adoption within the athletic community, making it a cornerstone of endurance training programs.

Altitude exposure triggers immediate physiological responses in the body. Within seconds, the body increases ventilation, attempting to breathe more to compensate for the reduced oxygen in each breath. However, despite this response, there is still a lower oxygen level throughout the circulatory system, resulting in reduced oxygen reaching the muscles. This limitation significantly impacts exercise performance. During the first few hours of altitude exposure, there is an increased loss of water, leading to dehydration. Altitude can also elevate metabolism while suppressing appetite, necessitating a higher food intake than what one may feel like consuming to maintain an energy balance. Over several days or weeks of altitude exposure, the body undergoes acclimation to adapt to the low-oxygen environment. The initial increase in breathing remains, and there is an elevation in haemoglobin levels (the oxygen-carrying protein in the blood) along with an increased ratio of blood vessels to muscle mass. Despite these adaptations, physical performance at altitude will always be inferior compared to equivalent activities at sea level. The exception to this is in brief and powerful activities such as throwing or hitting a ball, which can benefit from the reduced air resistance in high-altitude environments.

Past Research On Altitude

At Stanford University (Mah et al., n.d.), A study involving male basketball players explored the effects of extending sleep duration to 10 hours per night. The research Endeavor aimed to explore the potential positive outcomes resulting from this sleep extension. Notably, the findings of this investigation revealed large advancements in the players' athletic performance, particularly in terms of speed and shooting proficiency. Specifically, an enhancement in both half-court and full-court sprinting capabilities was observed, characterized by increased velocity and agility. The players' shooting accuracy also experienced a considerable positive growth, demonstrating a significant improvement of no less than 9%. These findings substantiate the hypothesis that optimizing sleep duration may yield substantial benefits in the realm of sports performance, showcasing the intricate relationship between sleep quality, physical prowess, and skill acquisition. This test was replicated at Stanford university (Mah et al., n.d.) on Male and female swimmers who extended their sleep to 10 hours also saw many performance improvements. Reaction times off diving blocks were faster, the test was then done on Varsity tennis players to see what benefits sleep had on skill acquisition sports. Male and female tennis players, who increased their sleep to at least nine hours a week also performed better. The accuracy of the players' serves increased significantly.

In a study conducted by Aul Robach, Laurent Schmitt, Julien V Brugniaux, and Belle Roles (2005), French swimmers underwent a unique training regimen involving exposure to hypoxic chambers. The study aimed to examine the effects of simulated high-altitude training on the swimmers' aerobic endurance and performance in short, high-intensity swims. The swimmers spent five days in hypoxic chambers set at an altitude equivalent to 2,500 meters, followed by an increase to 3,000 meters for eight subsequent nights. The results revealed a significant improvement in the swimmers' aerobic endurance, as evidenced by their ability to sustain longer swims at a faster pace. This indicated enhanced aerobic energy production, likely resulting from adaptations in their cardiovascular and respiratory systems, leading to improved oxygen delivery to the muscles. However, the study showed only a marginal improvement of 0.3 seconds in short-distance, high-intensity swims, suggesting limited effects on anaerobic power and sprinting capabilities. Therefore, while the swimmers' overall endurance improved, their ability to generate maximal force and sustain high-intensity efforts for brief durations remained relatively unaffected.

Athletes Research and Use of Altitude

Ross Edgely, a renowned British athlete and adventurer, incorporated altitude training into his rigorous training regimen to enhance his performance and endurance. Using altitude chambers or altitude 'masks', Edgely exposed himself to reduced oxygen levels simulating high-altitude conditions. This exposure stimulated adaptations within his cardiovascular and respiratory systems, leading to increased red blood cell production and improved oxygen utilization.

The benefits of Edgely's altitude training were twofold. Firstly, the enhanced aerobic endurance resulting from increased oxygen-carrying capacity allowed him to sustain prolonged physical efforts. This was particularly advantageous in his pursuits of long-distance swimming, running, and other endurance challenges. Secondly, the adaptations obtained through altitude training translated into improved performance at sea level. The physiological changes experienced at high altitude positively impacted his overall athletic abilities, enabling him to excel in various athletic endeavours.

Sleeping Research

In addition to altitude training, altitude sleeping, as observed in studies (conducted by Stanford university) (Mah et al., n.d.), involving basketball players and swimmers, has been found to positively impact athletic performance. Extending sleep duration to 10 hours per night or increasing sleep to at least nine hours a week has resulted in significant improvements in speed, shooting accuracy, reaction times, and skill acquisition. For elite runners, optimizing sleep duration can lead to improved recovery, enhanced cognitive function as the body can 'solidify 'information into the brain (Diekelmann, n.d.), and increased speed, agility, and muscular endurance. (Walsh et al., 2021)

Summary

Both altitude training and altitude sleeping have been shown to provide notable benefits to elite runners' performance. Altitude training, as demonstrated by the study involving French swimmers exposed to hypoxic chambers, can significantly enhance aerobic endurance. This improvement is attributed to adaptations within the cardiovascular and respiratory systems, resulting in increased oxygen delivery and improved energy production. For elite runners, this means they can sustain higher running intensities for longer durations, leading to improved race times and overall performance. Altitude training can also enhance runners' overall endurance capacity. By subjecting themselves to simulated high-altitude conditions, runners experience a physiological stress that triggers the production of additional red blood cells. These adaptations lead to improved oxygen-carrying capacity, enhancing runners' ability to utilize oxygen efficiently. This, in turn, allows them to maintain a faster pace over longer distances, providing a competitive edge in endurance events. (Sleep Foundation | Better Sleep for a Better You, 2023)

Hypothesis

Sleeping at high altitude forces the body to increase haemoglobin, which facilitates oxygen being carried around the body at an increased rate. This will then lead to more blood/oxygen being available to use during training or competition.

Methodology:

Preparation: Two months prior till entering Hypobaric chamber, collected data of blood tests and 1 km sprint times to figure out a base line performance, this can give an indication of base line data of performance, level before entering the 'chamber'.

Chamber cycle: for Three months (Two weeks gaining in altitude each night, to avoid hypoxia or altitude sickness, spend five nights at 2500m then two nights at 2200, to avoid any altitude sicknesses or hypoxia) at simulated altitude of 2500m, in the hypobaric chamber. Record (sleep times, fall asleep and wake up times, SPO_2, resting heart rate, altitude, deep sleep, light sleep and REM cycles, body activity and overall feel) and place said recordings in the excel file called sleep.

Training purposes: for the three months before and in the hypobaric chamber, training as normal during this time of year. But every week to record a 1 km time trial at Adcock athletics track. This is a distance where visible improvements can be seen, but also won't take an elongated amount of time to recover, so training can be continued as normal during the week, without any extra supplementation that could cause improvements outside of the hypobaric chamber.

Frequent blood test every month to track any changes within blood Levels, as blood levels will 'naturally' increase. This can be considered to be taking EPO (Erythropoietin (EPO) is a glycoprotein hormone, naturally produced by the peritubular cells of the kidney, that stimulates red blood cell production)

Results

Blood tests	20/01/2023	16/02/2023	9/03/2023	17/04/2023	3/07/2023
Haemoglobin	174	177	184	183	160
RCC	5.5	5.56	5.7	5.9	5.3
Harmatocrit	0.49	0.5	0.52	0.52	0.46
MVC	90	90	90	88	86
MCH	31.6	31.7	32	30.9	30.9
MCHC	353	355	357	353	359
RDW	11.9	12	12.1	11.7	11.7
WCC	7.2	6.8	6.6	7.1	5.8
Neutrophils	3.94	3.2	2.73	4.91	3.36
Lymphocytes	2.24	2.48	2.66	1.35	1.81
Monocytes	0.69	0.66	0.63	0.61	0.51
Eosinophils	0.32	0.5	0.59	0.2	0.08
Basophils	0.05	0.04	0.03	0.05	0.02
NRBC	<1.0	<1.0	<1.0	<1.0	<1.0
Platelets	318	322	329	363	558

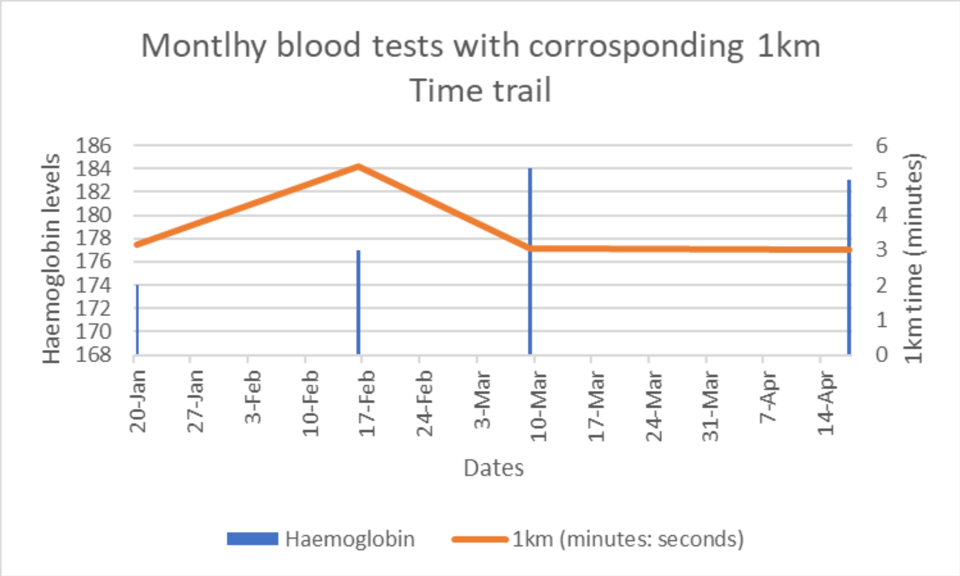
(Table 1, Monthly Full Blood Test with baseline test and 3 months after exiting the box)

1KM Time trial	time (min:sec)
Preparation	3:12
week1	3.14
week2	3.09
week3	3.02
week4	5.4
week5	5.2
week6	4.45
week7	3.04
week8	3.06
week9	2.58
week10	3.02
1 Month out	3:04

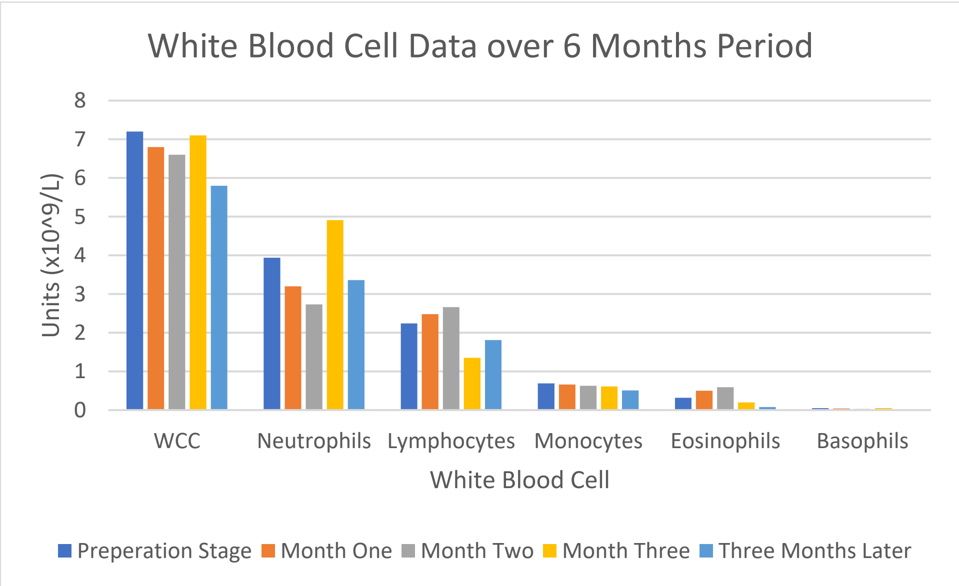
(Table 2, 1km time trial of each week with corresponding time)

Time trials After chamber	Time (Min:Sec)
Month 1	3:02
Month 2	3:04
Month 3	3:00

(Table 3, 1km time trial of months after exiting chamber)



(Graph 1 Monthly Blood test results with corresponding 1km time Trial)



(Graph 2 White Blood Cell Data Over 6 Month Period)

Discussion

Overall, the experiment did as intend; Haemoglobin Increased phenomenally, which subsequently reduced time taken to run one kilometre as shown in graph one as haemoglobin peaks after being in for a month and maintains at a high level for the rest of the time in the Chamber.

Preparation stage

The preparation stage encompassed the documentation of blood levels and the completion of a 1-kilometer run on an athletics track. This preliminary step aimed to establish a baseline measurement of performance levels. The initial blood test was conducted on January 20th, one month before the commencement of the chamber's usage period. This data acquisition process was undertaken to provide a reference point for assessing subsequent changes and developments in performance metrics over the course of the chamber's utilization.

Month One:

Month one was a success as the hypobaric chamber did as intend, five days were spent rising to the altitude of 2500 Meters, gaining 500 metres each night (this amount gained was worked out with medical professionals in accordance with the time span allocated. As the hypobaric chamber was a rental). During the first night’s heat was a problem, with temperatures reaching 30 degrees Celsius (portable air conditioner was used to lower temperatures). Blood test one of being inside the hypobaric chamber was as expected (table 1), rise in Haemoglobin and Haemoglobin count from 167- 177 g/l(177g/l exceeds the normal range for a human male adult.) this large spike was induced due to the lack of oxygen in the human body and my body experiencing less oxygenated blood as SpO_2 Was at the lowest points during the test at 75-80% which is quite severe as the range for a male adult is 90-100%, but what was surprising was the rise in White blood cell Lymphocytes as they went from 2.24-2.48 (10^9/l) this could be induced due to the fact the body was trying to combat altitude sickness/ acclimatize.

Month Two:

The hypobaric chamber and its integrated sensor system within the enclosure presented a significant challenge during the second month of the project. This problem was caused by an unanticipated power outage, which broke the Bluetooth connection connecting the chamber and the sensor components. Because of the cascading effects of this power loss on the hypobaric chamber's operation, the altitude unexpectedly rose. The altitude of the chamber increased from its starting point of 2000 meters to an elevated altitude of 4000 meters. This elevation gain took place over a reasonably brief period of 30 minutes (normal acclimatisation period for this altitude is 2-3 days of gradual gain in altitude to 4000 metres and 1-2days at 4000- metres, as recommended by the Library of Medicine Stephen R Muza 1, 2010), producing a noticeable incline of 2000 metres, this went unnoticed the first time as no side effects had a raised (except for a small headache which dissipated within 2 hours). But, the second time this occurred larger side effects raised with hypoxia, and altitude illness.

With the sudden increase in altitude to 4000 meters due to the unexpected ascent of the chamber, a remarkable decrease in white blood cells as in month two and month three both White blood cell count and Neutrophiles and Monocytes, as many white blood cells would have been taken to try to fight the pathogen of Hypoxia and low levels would indicate that they are being used and not many ‘free floating’ white blood cells, This phenomenon underscores the rapid responsiveness of our bodies to potential pathogens, such as hypoxia-induced conditions like altitude sickness. The swift decline in white blood cell levels serves as a vivid illustration of the body's capacity to mount a prompt immune response in the face of physiological challenges caused by changing environmental conditions. This occurrence lends valuable insights into the dynamic interplay between altitude-induced stressors and the immune system's ability to adapt and safeguard our well-being.

This sent progress into a spin as Hypoxia was contracted, due to the climb in altitude. this caused for time out of the hypobaric chamber until personal health was back to applicable levels. (this stretch lasted the last week of Month Two and the First of Month three. But the Haemoglobin did continue to increase as they reached 184g/L which was the highest level of haemoglobin levels during the test. which may, again be a reason why white blood cells were so low as there is only so much room in the blood vessels.

Month Three

Month three was a slow start whilst recovery was in progress during the first week. Once continuation of the chamber began time to reach altitude of 2000 meters was slower, only increasing 3000 metres each night. This allowed for better acclimatisation. The hypobaric chamber was also capped at maximum input of 3000metres (this meant time to reach altitude was slower). Blood levels remained the same as month two will little increase in areas (both red cell count at 5.9g/l, haemoglobin 183g/l) But White blood cells remained at a high during this period at 7.1 and neutrophiles as they reached an all time high of 4.91 (10^9/l). this was caused as they body had created more antibodies.

After two weeks in the hypobaric chamber (week three of moth three), the Hypobaric chamber started to make a strange noise that was concerning, with consultation of teachers and medical professionals, the hypobaric chamber was stopped one week early. But training and weekly time trial was reaching peak times of low Three minutes, to even under three minutes in some, (Two Minutes Fifty eight second being the fastest of the times at week 9).

Months After The Hypobaric Chamber

Months after the chamber saw a maintenance of blood levels for the first 3-4 weeks after, then was a steady decline to 'base levels' some parts reaching lower then pre-chamber months, Haemoglobin Reaching 164 g/l slightly 'under average' level, but still healthy (adult males levels being 138-172 g/L) But time trials was at a continued level as one month out of the chamber was three minutes two seconds, Two months out of chamber was three minutes four seconds and three months out was 3minutes flat.

Conclusion

Engaging in physical training amidst natural environments subjects the human body to stress, thereby acting as a primary stressor. The introduction of elevated altitude, characterized by reduced oxygen availability, further compounds this stress effect, resulting in the simultaneous presence of dual stressors. This concurrent exposure impedes the body's capacity to fully acclimate to these stressors namely, the combined challenges of training and high altitude—thus inhibiting the attainment of optimal adaptations.

However, a notable alternative emerges through the practice of sleeping at high altitudes. By immersing the body in an elevated environment during rest, a natural acclimatization process takes place. This adjustment, or acclimatization, encompasses the body's gradual accommodation to the diminished oxygen concentration in the atmosphere. Consequently, the body orchestrates the augmentation of haemoglobin production, a physiological response that facilitates the maintenance of a 'normal' rate of oxygen respiration.

The results show that the introduction of altitude, when the human body is at a resting state allows the body to adapt and acclimatize to the altitude at a more efficient rate and can be implemented and impact the performance levels of an athlete’s 1 kilometre performance. As the body is naturally better at oxygen respiration and circulation of oxygenated blood.

Reference list:

1. Diekelmann, S. (n.d.). Sleep for cognitive enhancement. Frontiers in Systems Neuroscience. Retrieved August 17, 2023 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3980112/

2. Dr Andrew Huberman. (2021). Mastering Sleep [How to improve sleep and master wakefulness]. Neurobiology, Stanford University.

3. Edgely, Ross. (2016). Art of Resilience. Eddie Hall.

4. Edgely, Ross. (2021). Ross Edgely Blueprint. Eddie Hall.

5. Erlacher, D., F. Ehrlenspiel, O.A. Adegbesan, And H.G. El-Din. (2011). Sleep habits in German athletes before important competitions or games [Paper presentation]. J. Sports Sci.

6. Hauser, A. (2017). Do male athletes with already high initial haemoglobin mass benefit from ‘live high–train low’ altitude training? [PDF]. Swiss Federal Institute of Sport.

7. Jurak, Scott. (2018). Eat and Run. Houghton Mifflin Harcourt.

8. Mah, C. D., Mah, K. E., Kezirian, E. J., & Dement, W. C. (n.d.). The Effects of Sleep Extension on the Athletic Performance of Collegiate Basketball Players. Sleep. Retrieved August 17, 2023 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3119836/

9. Mah, C.D., K.E. Mah, E.J. Kezirian, And W.C. Dement. (2011). The effects of sleep extension on the athletic performance of collegiate basketball players [Paper presentation]. NA.

10. Matt Cranney. (2022, November 2). Altitude effects [Lecture 1 on 1]. Physio, Coast Sport.

11. Moore, L. G., & Regenstein, J. G. (1983). Adaptation to High Altitude. *Annual Review of Anthropology*, *12*, 285–304. http://www.jstor.org/stable/2155649/

12. Shona L. Halson, PhD. (2017). Performance. (01). Sleep and Athletes. https://www.gssiweb.org/sports-science-exchange/article/sse-167-sleep-and-athletes#:~:text=Faster%20sprint%20times%20and%20increased,increased%20vigour%20and%20decreased%20fatigue.&text=While%20limited%2C%20this%20data%20suggests,receives%20may%20significantly%20enhance%20performance

13. Sleep Foundation | Better Sleep for a Better You. (2023, March 03). Sleep Foundation. Retrieved August 17, 2023 from https://www.sleepfoundation.org/

14. Stephen R Muza 1, Beth A Beidleman, Charles S. Fulco. (2010). *Altitude preexposure recommendations for inducing acclimatization.* National Library of Medicine. https://pubmed.ncbi.nlm.nih.gov/20586592/#:~:text=The%20available%20evidence%20suggests%20that,rapid%20ascent%20to%204300%20m

15. This man just swam around the entire Great British mainland. (n.d.). Retrieved November 24, 2022 from https://www.redbull.com/au-en/ross-edgley-completes-great-british-swim/

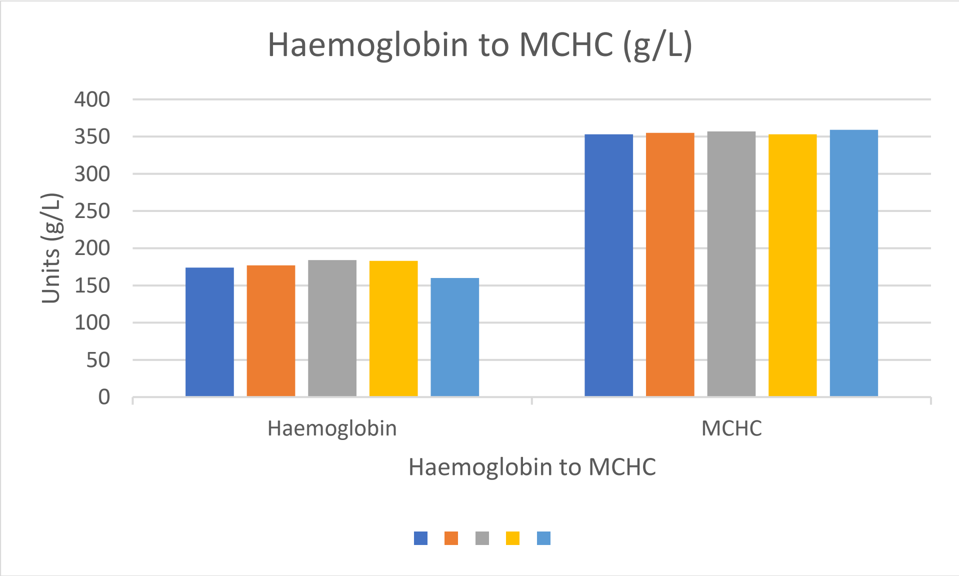
16. Waterhouse, J., G. Atkinson, B. Edwards, And T. Reilly. (2007). The role of a short post- lunch nap in improving cognitive, motor, and sprint performance in participants with partial sleep deprivation [Paper presentation]. J. Sports Sci. 25:1557-66.

17. Watson Am. (n.d.). Sleep and Athletic Performance. Current Sports Medicine Reports. Retrieved August 17, 2023 from https://pubmed.ncbi.nlm.nih.gov/29135639/

18. Watson, & M, A. (n.d.). Sleep and Athletic Performance: Current Sports Medicine Reports. Current Sports Medicine Reports. Retrieved August 17, 2023 from https://journals.lww.com/acsm-csmr/fulltext/2017/11000/sleep_and_athletic_performance.11.aspx

19. Walsh, N. P., Halson, S. L., Sargent, C., Roach, G. D., Nédélec, M., Gupta, L., Leeder, J., Fullagar, H. H., Coutts, A. J., Edwards, B. J., Pullinger, S. A., Robertson, C. M., Burniston, J. G., Lastella, M., Meur, Y. L., Hausswirth, C., Bender, A. M., Grandner, M. A., & Samuels, C. H. (2021, April 01). Sleep and the athlete: Narrative review and 2021 expert consensus recommendations. British Journal of Sports Medicine. Retrieved August 17, 2023 from https://bjsm.bmj.com/content/55/7/356

Appendices



(Graph 3 Haemoglobin to MCHC g/L)

Day	altitude	heart rate (bpm)	SP02(%)	Deep sleep (hr,min)	Light sleep	REM
14-Mar	500m	65	91	4hr, 19min	5hr20min	/
15-Mar	500m	65	90	1hr46min	6hr38min	/
16-Mar	700m	64	89	2hr39min	5hr59min	/
17-Mar	700m	64	88	2hr	6hr5	/
18-Mar	1000m	65	96	/	3hr56min	3h34min
19-Mar	1000m	64	96	/	5hr20min	3hr19min
20-Mar	1500m	65	94	13min	4hr45min	3hr 28min
21-Mar	2000m	61	95	/	5hr38min	4hr20min
22-Mar	2000m	68	93	17min	5hr56min	3hr19min
23-Mar	2200m	65	94	/	5hr	3hr25
24-Mar	2200m	66	93	/	5hr 26min	3hr21min
25-Mar	2400m	66	94	20min	4hr 51min	3hr18min
26-Mar	2400m	62	95	1 hr 46	6hr	38min
27-Mar	2500m	64	95	/	4hr 44min	4hr10min
28-Mar	2500m	66	94	/	6hr 26min	3hr 33min

29-Mar	2500m	63	94	28min	4hr20	4hr 28min
30-Mar	2500m	63	93	/	6hr23min	3hr 27m
31-Mar	2500m	69	93	/	3hr57min	4hr26min
1-Apr	2500m	64	93	1hr	6hr5min	1hr
2-Apr	1900m	65	96	25min	4 hr 51min	3hr16min
3-Apr	200m	63	94	4hr	5hr 39min	/
4-Apr	2200m	68	92	28min	5hr55min	2hr 47min
5-Apr	2500m	71	91	/	5hr 41min	4hr 13min
6-Apr	2500m	68	91	5min	5hr 13min	3hr 16min
7-Apr	2500m	66	91	2min	4hr 38min	4hr 44min
8-Apr	2500m	65	92	/	5hr35min	2hr 3m
9-Apr	1900m	66	93	14min	5hr16min	1hr53min
10-Apr	0m	59	97	15min	4hr15min	2hr53min
11-Apr	0m	64	94	/	6hr	2hr 43min
12-Apr	0m	68	92	1hr	5hr30min	2hr30min

(Table 4, nightly recordings part 1)

Day	altitude	duration	fell asleep	wake up	body activity	CO2	Dream activity
14-Mar	500m	9hr39min	8.49pm	6.41am	low to mid	1800	/
15-Mar	500m	8hr 24min	10.13pm	6.39am	low	1800	/
16-Mar	700m	8hr 38min	9.32pm	6.21pm	mid to high	1800	/
17-Mar	700m	8hr5min	9.25pm	6.30am	mid	1800	/
18-Mar	1000m	7hr 30min	9.11pm	4.51am	mid to high	1802	y
19-Mar	1000m	8hr39min	9.29pm	6.20am	low to mid	1801	y
20-Mar	1500m	8hr26min	9.51pm	6.22am	low	1800	/

21-Mar	2000m	9hr58min	8.41pm	6.50am	mid to high	1800	/
22-Mar	2000m	9hr32min	8.52pm	6.42am	mid	1800	y
23-Mar	2200m	8hr25min	8.40pm	5am	low-mid	1800	y
24-Mar	2200m	8hr 47min	8.46pm	6.50am	mid	1800	y
25-Mar	2400m	8hr29min	9.52pm	6.56am	low	1800	y
26-Mar	2400m	8hr 24min	10.1pm	6.42am	low	1802	/
27-Mar	2500m	8hr 54min	8.41pm	5.46am	mid	1800	y
28-Mar	2500m	9hr 59min	8.41pm	6.47min	low	1800	/
29-Mar	2500m	9hr 16m	9..05pm	6.35am	low	1800	y
30-Mar	2500m	9hr 50min	8.44pm	649am	low	1800	/
31-Mar	2500m	8hr 23min	10.49pm	7.41am	mid	1800	/
1-Apr	2500m	8hr 5min	9.20pm	6.25am	high	1800	/
2-Apr	1900m	8hr 29min	8.52pm	5.56am	low to mid	1800	/
3-Apr	200m	9hr 39min	9.49pm	7.41am	high	1800	/
4-Apr	2200m	9hr 10min	8.29pm	6.04am	low	1800	/
5-Apr	2500m	9hr 54min	8.40pm	6.39am	low	1800	y
6-Apr	2500m	8hr 34min	9.10pm	5.50am	low to mid	1800	y
7-Apr	2500m	9hr 24min	8.15pm	5.55am	mid	1800	/
8-Apr	2500m	7hr38min	8.20pm	4.18am	low	1800	y
9-Apr	1900m	7hr 23min	8.40pm	4.07 am	low	1800	y
10-Apr	0m	7hr24min	9.41pm	5.08am	low	1800	/
11-Apr	0m	8hr 43min	8.28pm	5.30am	low	1800	/
12-Apr	0m	9hr	9.29pm	6.29am	low	1800	/

(Table 5, nightly recordings Part 2)