SUPPLEMENTAL MATERIAL

Is daytime napping an effective strategy to improve sport-related cognitive and physical performance and reduce perceived fatigue? A systematic review and meta-analysis of randomized controlled trials

Table S2. Search strategy (December 2, 2022) detailed for each database.

PubMed:
(napping OR siesta OR nap OR "nap sleep" OR "nap time" OR "day sleep" OR "daytime sleep" OR "daytime nap" OR "daytime napping" OR "day time sleep" OR "day time nap" OR "day time napping" OR "day-time sleep" OR "day-time nap" OR "day-time napping") AND (exercise OR "physical activity" OR fitness OR "physical performance" OR "sport performance" OR training OR "physical exercise" OR "athletic performance" OR fatigue OR exertion OR exhaustion)
Scopus:
TITLE-ABS-KEY (napping OR siesta OR nap OR "nap sleep" OR "nap time" OR "day sleep" OR "daytime sleep" OR "daytime nap" OR "daytime napping" OR "day time sleep" OR "day time nap" OR "day time napping" OR "day-time sleep" OR "day-time nap" OR "day-time napping") AND TITLE-ABS-KEY (exercise OR "physical activity" OR fitness OR "physical performance" OR "sport performance" OR training OR "physical exercise" OR "athletic performance" OR fatigue OR exertion OR exhaustion)
Web of Science:
TS=(napping OR siesta OR nap OR "nap sleep" OR "nap time" OR "day sleep" OR "daytime sleep" OR "daytime nap" OR "daytime napping" OR "day time sleep" OR "day time nap" OR "day time napping" OR "day-time sleep" OR "day-time nap" OR "day-time napping") AND TS=(exercise OR "physical activity" OR fitness OR "physical performance" OR "sport performance" OR training OR "physical exercise" OR "athletic performance" OR fatigue OR exertion OR exhaustion)
Cochrane CENTRAL:
(napping OR siesta OR nap OR "nap sleep" OR "nap time" OR "day sleep" OR "daytime sleep" OR "daytime nap" OR "daytime napping" OR "day time sleep" OR "day time nap" OR "day time napping" OR "day-time sleep" OR "day-time nap" OR "day-time napping") AND (exercise OR "physical activity" OR fitness OR "physical performance" OR "sport performance" OR training OR "physical exercise" OR "athletic performance" OR fatigue OR exertion OR exhaustion) *in Title Abstract Keyword - (Word variations have been searched)*
SportDiscus:
AB (napping OR siesta OR nap OR "nap sleep" OR "nap time" OR "day sleep" OR "daytime sleep" OR "daytime nap" OR "daytime napping" OR "day time sleep" OR "day time nap" OR "day time napping" OR "day-time sleep" OR "day-time nap" OR "day-time napping") AND AB (exercise OR "physical activity" OR fitness OR "physical performance" OR "sport performance" OR training OR "physical exercise" OR "athletic performance" OR fatigue OR exertion OR exhaustion)
PsycInfo:
AB (napping OR siesta OR nap OR "nap sleep" OR "nap time" OR "day sleep" OR "daytime sleep" OR "daytime nap" OR "daytime napping" OR "day time sleep" OR "day time nap" OR "day time napping" OR "day-time sleep" OR "day-time nap" OR "day-time napping") AND AB (exercise OR "physical activity" OR fitness OR "physical performance" OR "sport performance" OR training OR "physical exercise" OR "athletic performance" OR fatigue OR exertion OR exhaustion)

Table S3. Excluded studies by reason for exclusion (n = 68).

Non stated physically active individuals (n = 18)
1. Albouy, G., et al., Daytime Sleep Enhances Consolidation of the Spatial but Not Motoric Representation of Motor Sequence Memory. Plos One, 2013. 8(1).
2. Amin, M.M., et al., The effects of a mid-day nap on the neurocognitive performance of first-year medical residents: a controlled interventional pilot study. Acad Med, 2012. 87(10): p. 1428-1433.
3. Chang, H.J., et al., Association Between Nap and Reported Cognitive Function and Role of Sleep Debt: A Population-Based Study. J Clin Neurol, 2022. 18(4): p. 470-477.
4. Du, J., et al., Planning Ability and Alertness After Nap Deprivation: Beneficial Effects of Acute Moderate-Intensity Aerobic Exercise Greater Than Sitting Naps. Front Public Health, 2022. 10: p. 861923-861923.
5. Fang, Z., et al., Differential Effects of a Nap on Motor Sequence Learning-Related Functional Connectivity Between Young and Older Adults. Front Aging Neurosci, 2021. 13: p. 747358-747358.
6. Fitzroy, A.B., et al., Encoding and consolidation of motor sequence learning in young and older adults. Neurobiol Learn Mem, 2021. 185: p. 107508-107508.
7. Korman, M., et al., Daytime sleep condenses the time course of motor memory consolidation. Nat Neurosci, 2007. 10(9): p. 1206-1213.
8. Kubo, T., et al., Impact of nap length, nap timing and sleep quality on sustaining early morning performance. Industrial Health, 2007. 45(4): p. 552-563.
9. Mograss, M., et al., Exercising before a nap benefits memory better than napping or exercising alone. Sleep, 2020.
10. Monk, T.H., et al., Effects of afternoon "siesta" naps on sleep, alertness, performance, and circadian rhythms in the elderly. Sleep, 2001. 24(6): p. 680-687.
11. Rosenbloom, T. and E.S. Grossman, Assessment of performance impairment after short naps with and without sleep inertia. Transportation Research Part F: Traffic Psychology and Behaviour, 2018. 52: p. 1-13.
12. Tietzel, A.J. and L.C. Lack, The recuperative value of brief and ultra-brief naps on alertness and cognitive performance. Journal of Sleep Research, 2002. 11(3): p. 213-218.
13. Tucker, M.A., et al., A daytime nap containing solely non-REM sleep enhances declarative but not procedural memory. Neurobiol Learn Mem, 2006. 86(2): p. 241-247.
14. Ukraintseva, Y.V. and V.B. Dorokhov, Effects of daytime sleep on the consolidation of declarative memory in humans. Neuroscience and Behavioral Physiology, 2012. 42(7): p. 700-706.
15. Wamsley, E.J., et al., A brief nap is beneficial for human route-learning: The role of navigation experience and EEG spectral power. Learn Mem, 2010. 17(7): p. 332-336.
16. Watanabe, K., et al., Effects of 90 Min Napping on Fatigue and Associated Environmental Factors among Nurses Working Long Night Shifts: A Longitudinal Observational Study. International Journal of Environmental Research and Public Health, 2022. 19(15).
17. Waterhouse, J., et al., The role of a short post-lunch nap in improving cognitive, motor, and sprint performance in participants with partial sleep deprivation. J Sports Sci, 2007. 25(14): p. 1557-1566.
18. Woud, M.L., et al., Does napping enhance the effects of Cognitive Bias Modification-Appraisal training? An experimental study. PLoS ONE, 2018. 13(2): p. e0192837-e0192837.

Reviews (n = 13)
1. Arakaki FH, Tufik S, Andersen ML. Naps and exercise: reinforcing a range of benefits for elderly health. 2019. p. 886-7.
2. Bonnar D, Bartel K, Kakoschke N, Lang C. Sleep Interventions Designed to Improve Athletic Performance and Recovery: A Systematic Review of Current Approaches. *Sports Med* 2018; **48**(3): 683-703.
3. Botonis PG, Koutouvakis N, Toubekis AG. The impact of daytime napping on athletic performance - A narrative review. *Scand J Med Sci Sports* 2021; **31**(12): 2164-77.
4. Dutheil F, Danini B, Bagheri R, et al. Effects of a Short Daytime Nap on the Cognitive Performance: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health* 2021; **18**(19).

5. Fullagar HHK, Duffield R, Skorski S, Coutts AJ, Julian R, Meyer T. Sleep and recovery in team sport: Current sleep-related issues facing professional team-sport athletes. *International Journal of Sports Physiology and Performance* 2015; **10**(8): 950-7.
6. Gupta L, Morgan K, North C, Gilchrist S. Napping in high-performance athletes: Sleepiness or sleepability? *Eur J Sport Sci* 2021; **21**(3): 321-30.
7. Lastella M, Halson SL, Vitale JA, Memon AR, Vincent GE. To Nap or Not to Nap? A Systematic Review Evaluating Napping Behavior in Athletes and the Impact on Various Measures of Athletic Performance. *Nat Sci Sleep* 2021; **13**: 841-62.
8. Nedelec M, Halson S, Abaidia A-EE, et al. Stress, Sleep and Recovery in Elite Soccer: A Critical Review of the Literature. *Sports Med* 2015; **45**(10): 1387-400.
9. Nedelec M, Halson S, Delecroix B, et al. Sleep Hygiene and Recovery Strategies in Elite Soccer Players. *Sports Med* 2015; **45**(11): 1547-59.
10. O'Donnell S, Beaven CM, Driller MW, O'donnell S, Beaven CM, Driller MW. From pillow to podium: a review on understanding sleep for elite athletes. *Nat Sci Sleep* 2018; **10**: 243-53.
11. Sargent C, Lastella M, Halson SL, Roach GD. The impact of training schedules on the sleep and fatigue of elite athletes. *Chronobiol Int* 2014; **31**(10): 1160-8.
12. Souabni M, Hammouda O, Romdhani M, Trabelsi K, Ammar A, Driss T. Benefits of Daytime Napping Opportunity on Physical and Cognitive Performances in Physically Active Participants: A Systematic Review. *Sports Med* 2021.
13. Walsh NP, Halson SL, Sargent C, et al. Sleep and the athlete: Narrative review and 2021 expert consensus recommendations. *British Journal of Sports Medicine* 2021; **55**(7): 356-68.

Study design (n = 9)
1. Knechtle, B., et al., No Improvement in Race Performance by Naps in Male Ultra-Endurance Cyclists in a 600-km Ultra-Cycling Race. Chinese Journal of Physiology, 2012. 55(2): p. 125-133.
2. Kong, L., Y. Cui, and Q. Gong, Duration of Daytime Napping Is Related to Physical Fitness among Chinese University Students. Int J Environ Res Public Health, 2022. 19(22).
3. Lastella, M., et al., The impact of training load on sleep during a 14-day training camp in elite, adolescent, female basketball players. International Journal of Sports Physiology and Performance, 2020. 15(5): p. 724-730.
4. Lubin, A., et al., Effects of exercise, bedrest and napping on performance decrement during 40 hours. Psychophysiology, 1976. 13(4): p. 334-339.
5. O'Donnell, S., C.M. Beaven, and M. Driller, The Influence of Match-Day Napping in Elite Female Netball Athletes. Int J Sports Physiol Perform, 2018. 13(9): p. 1143-1148.
6. Pelka, M., et al., How Does a Short, Interrupted Recovery Break Affect Performance and How Is It Assessed? A Study on Acute Effects. Int J Sports Physiol Perform, 2017. 12(Suppl 2): p. S2114-s2121.
7. Rachiwong, S. and B. Benjapalakorn, A 10-Minute Napping Can Help in Recovery in Motor Performance. Journal of Exercise Physiology Online, 2022. 25(3): p. 70-81.
8. Wei, W. and W. Liu, Sleep Pattern Is Related to Mental Health among Chinese Collegiate Student Athletes. Int J Environ Res Public Health, 2022. 19(15).
9. Wilson, S.G. and J. Baker, Exploring the relationship between sleep and expertise in endurance sport athletes. International Journal of Sport and Exercise Psychology, 2021. 19(5): p. 866-881.

No data of interest (n = 8)
1. Ammar, A., et al., The effect of a daytime 60-min nap opportunity on postural control in highly active individuals. Biol Sport, 2021. 38(4): p. 683-691.
2. Calleja-González, J., et al., Recovery strategies for sports performance in the spanish professional basketball league (Acb). Cultura, Ciencia y Deporte, 2021. 16(49): p. 411-424.
3. Gattoni, C., et al., Sleep Deprivation Training to Reduce the Negative Effects of Sleep Loss on Endurance Performance: a Single Case Study. International journal of sports physiology and performance, 2022. 17(3): p. 499-503.

4. Keramidas, M.E., et al., A brief pre-exercise nap may alleviate physical performance impairments induced by short-term sustained operations with partial sleep deprivation–A field-based study. Chronobiology International, 2018. 35(10): p. 1464-1470.
5. Peng, L., et al., Effects of Midday Nap Duration on Nighttime Sleep Quality in Elite Athletes. Journal of Tianjin Institute of Sport / Tianjin Tiyu Xueyuan Xuebao, 2018. 33(3): p. 224-229.
6. Romdhani, M., et al., Total Sleep Deprivation and Recovery Sleep Affect the Diurnal Variation of Agility Performance: The Gender Differences. Journal of strength and conditioning research, 2021. 35(1): p. 132-140.
7. Romyn, G., et al., Daytime naps can be used to supplement night-time sleep in athletes. Chronobiol Int, 2018. 35(6): p. 865-868.
8. Yagin, F.H., et al., A Thirty-Minute Nap Enhances Performance in Running-Based Anaerobic Sprint Tests during and after Ramadan Observance. International journal of environmental research and public health, 2022. 19(22).

Participants younger than 18 years (n = 8)
1. Harris, A., et al., A Comparative Study of Sleep and Mood Between Young Elite Athletes and Age-Matched Controls. J Phys Act Health, 2017. 14(6): p. 465-473.
2. Lolli, L., et al., An objective description of routine sleep habits in elite youth football players from the Middle-East. Sleep Medicine, 2021. 80: p. 96-99.
3. Luke, A., et al., Sports-related injuries in youth athletes: is overscheduling a risk factor? Clin J Sport Med, 2011. 21(4): p. 307-314.
4. Maier, J.G., et al., Brief periods of NREM sleep do not promote early offline gains but subsequent on-task performance in motor skill learning. Neurobiology of Learning and Memory, 2017. 145: p. 18-27.
5. Saito, K., et al., The effects of a short nap during the daytime on the athletic performance of elementary school basketball players. Japanese Journal of Physical Fitness and Sports Medicine, 2021. 70(3): p. 219-228.
6. Suppiah, H.T., et al., Effects of a Short Daytime Nap on Shooting and Sprint Performance in High-Level Adolescent Athletes. International Journal of Sports Physiology and Performance, 2019. 14(1): p. 76-82.
7. Suppiah, H.T., et al., Sleep Characteristics of Elite Youth Athletes: A Clustering Approach to Optimize Sleep Support Strategies. Int J Sports Physiol Perform, 2021: p. 1-9.
8. 齊藤 訓英, et al., The effects of a short nap during the daytime on the athletic performance of elementary school basketball players. Japanese Journal of Physical Fitness and Sports Medicine, 2021. 70(3): p. 219-228.

Non eligible publications (n = 7)
1. Ando, K., et al., Effects of Nap After Morning Exercise on Afternoon Performance and Overnight Sleep in Athletes. Medicine and Science in Sports and Exercise, 2019. 51(6): p. 752-752.
2. Driss, T., et al., Diurnal nap could enhance recovery process and counteract the negative effect of partial sleep deprivation on physical and cognitive performances. Acta Physiologica, 2021. 233.
3. Petretta, A., et al., The Effect Of Nap Duration On Sleep Inertia, Muscle Strength, And 3-km Cycling Time Trial Performance. Medicine and Science in Sports and Exercise, 2020. 52(17): p. 501-501.
4. Romyn, G., et al., SPRINT ABILITY AND REACTION TIME FOLLOWING A 2-HOUR NAP IN SOCCER PLAYERS. Sleep, 2017. 40: p. A71-A71.
5. Romyn, G., et al., Readiness To Perform, Sprint Ability, And Reaction Time Following A 2-hour Nap In Soccer Players. Medicine and Science in Sports and Exercise, 2017. 49(5): p. 570-570.
6. Tanabe, K., K. Nakazato, and S. Noi, NINETY-MINUTE RECOVERY NAP FOLLOWING AEROBIC EXERCISE IMPROVES EXECUTIVE FUNCTION IN MALE COLLEGIATE STUDENTS. Sleep, 2019. 42.
7. Willmer, F., et al., Napping improves wakefulness in athletes but has less influence on endurance performance. Sleep medicine, 2022. 31: p. S181--S181-.

Duplicated data from other study (n = 5)
1. Boukhris, O., et al., Performance, muscle damage, and inflammatory responses to repeated high-intensity exercise following a 40-min nap. Res Sports Med, 2021: p. 1-18.

2. Boukhris, O., et al., Physiological response and physical performance after 40 min and 90 min daytime nap opportunities. Res Sports Med, 2022: p. 1-14.
3. Romdhani, M., et al., The Effect of Experimental Recuperative and Appetitive Post-lunch Nap Opportunities, With or Without Caffeine, on Mood and Reaction Time in Highly Trained Athletes. Front Psychol, 2021. 12: p. 720493.
4. Romdhani, M., et al., The effect of caffeine, nap opportunity and their combination on biomarkers of muscle damage and antioxidant defence during repeated sprint exercise. Biology of Sport, 2022. 39(4): p. 1033-1042.
5. Romdhani, M., et al., Caffeine Use or Napping to Enhance Repeated Sprint Performance After Partial Sleep Deprivation: Why Not Both? Int J Sports Physiol Perform, 2021. 16(5): p. 711-718.

Table S4. Specific tests used in each study for each outcome analyzed.

Authors, Year	Cognitive Performance	Physical Performance	Fatigue
Abdessalem et al., 2019	Digit cancellation test	5 m shuttle run test [to determine best distance (BD), total distance (TD)]	Rating of perceived exertion (RPE)
Ajjimaporn et al., 2020	Auditory reaction time	Running-based Anaerobic Sprint Test (RAST), Isometric leg strength test	RPE
Blanchfield et al., 2018	None	Endurance performance: Time to exhaustion (TTE) at 90% $\dot{V}O_2$max	Brunel Mood Scale (BRUMS), item fatigue
Boukhris et al., 2019	None	5 m shuttle run test [to determine best distance (BD), total distance (TD)]	RPE and Fatigue index
Boukhris et al., 2020	Digit cancellation test	5-m shuttle run test (BD and TD), and the maximal voluntary isometric contraction (MVIC) test	RPE and Fatigue index
Boukhris et al., 2022	None	5 m shuttle run test [to determine great distance (GD), total distance (TD)]	RPE and Fatigue index
Brotherton et al., 2018	Alertness	Submaximal weightlifting performance (one-repetition maximum (1RM) for bench press and inclined leg press)	RPE, tiredness
Daaloul et al., 2018	Alertness, simple reaction time, mental rotation test and lower reaction test	Squat jump (SJ), counter movement jump (CMJ), KST	Fatigue (0-100 VAS)
Hammouda et al., 2018	None	Running-based anaerobic sprint test	Fatigue index (results unavailable)
Hsouna et al., 2019	Digit cancellation test	5-jump test	The Hooper questionnaire
Hsouna et al., 2020a	Digit cancellation test	5 m shuttle run test	RPE
Hsouna et al., 2020b	Digit cancellation test	5 m shuttle run test	RPE
Hsouna et al., 2022	None	5 m shuttle run test	RPE
Petit et al., 2014	None	Wingate test	Fatigue index
Petit et al., 2018	P300, an Auditory Event-related potentials (ERP), subjective alertness (VAS) and an Attentional Performance (TAP-M): alertness, divided attention, sustained attention, visual scanning, flexibility and distractibility)	None	None
Romdhani et al., 2020	Simple reaction time, Multi-choice reaction time	Running-Based Anaerobic Sprint Test (RAST)	RPE and Fatigue index
Romdhani et al., 2021	Multi-choice reaction time (s)	Running-Based Anaerobic Sprint Test (RAST)	None
Romyn et al., 2022	Response time	3-m split, 5-m split, 10-m print, agility	Perceived exertion

Souabni et al., 2022	None	Defensive (DA) and offensive (OA) agility, upper body power (UBP), Shooting skills test (SST)	RPE and Fatigue index
Souissi et al., 2020	Simple reaction time	5-m shuttle run test	Fatigue index
Tanabe et al. 2018	Simple reaction time, Multi-choice reaction time, Modified flanker task	Grip strength (right and left hands), Back strength, Wingate test (mean and peak power)	None
Yamamoto and Hayashi, 2006	None	Exercise duration	RPE

Table S5. Analysis of the distribution of outcomes according to mean (x), standard deviation (sd) and x/sd ratio in the intervention (Nap) and control (No-nap) groups.

Reference	Sample size	Nap duration	Outcome	Test	x-Nap	sd-Nap	x-sd-Nap ratio	x-No-nap	sd-No-nap	x-sd-No-nap ratio
Romdhani et al, 2021	14	20 min	COGN	MCRT			***			***
Abdessalem et al, 2019	18	25 min	COGN	NCORR	69.00	11.00	6.27	65.00	9.00	7.22
Hsouna et al, 2019	20	25 min	COGN	NCR	67.80	3.30	20.55	65.00	3.20	20.31
Hsouna et al, 2020a	12	25 min	COGN	DCT	65.60	11.40	5.75	65.80	10.00	6.58
Daaloul et al, 2019	13	30 min	COGN	ALERT	7.10	1.30	5.46	5.60	2.20	2.55
Daaloul et al, 2019	13	30 min	COGN	SRT	278.70	24.90	11.19	21.00	8.00	2.63
Daaloul et al, 2019	13	30 min	COGN	MRT	21.00	8.00	2.63	20.80	8.40	2.48
Soussi et al, 2020	14	30 min	COGN	VIGIL	71.50	1.10	65.00	68.60	1.00	68.60
Soussi et al, 2020	14	30 min	COGN	REACT	0.31	0.01	61.00	0.28	0.01	46.33
Tanabe et al, 2020	7	30 min	COGN	SRT	307.40	21.90	14.04	283.00	14.90	18.99
Tanabe et al, 2020	7	30 min	COGN	MRT	381.10	43.20	8.82	348.00	24.60	14.15
Hsouna et al, 2019	20	35 min	COGN	NCR	69.80	3.30	21.15	65.00	3.20	20.31
Hsouna et al, 2020b	14	35 min	COGN	ATTS	67.64	2.78	24.33	64.50	2.52	25.60
Boukhris et al, 2020	14	40 min	COGN	ATTS	85.00	12.00	7.08	79.00	11.00	7.18
Boukhris et al, 2020	14	40 min	COGN	MVIC	812.00	100.00	8.12	769.00	94.00	8.18
Hsouna et al, 2019	20	45 min	COGN	NCR	71.00	3.50	20.29	65.00	3.20	20.31
Romyn et al, 2022	12	60 min	COGN	RESPT	224.00	28.28	7.92	217.00	17.67	12.28
Tanabe et al, 2020	7	60 min	COGN	SRT	307.40	21.90	14.04	284.80	7.60	37.47
Tanabe et al, 2020	7	60 min	COGN	MRT	381.10	43.20	8.82	365.90	14.30	25.59
Boukhris et al, 2020	14	90 min	COGN	ATTS	87.00	13.00	6.69	79.00	11.00	7.18
Boukhris et al, 2020	14	90 min	COGN	MVIC	843.00	102.00	8.26	769.00	94.00	8.18
Romdhani et al, 2021	14	90 min	COGN	MCRT			***			***
Tanabe et al, 2020	7	90 min	COGN	SRT	307.40	21.90	14.04	289.70	14.30	20.26
Tanabe et al, 2020	7	90 min	COGN	MRT	381.10	43.20	8.82	353.10	24.70	14.30
Romyn et al, 2022	12	120 min	COGN	RESPT	202.00	22.98	8.79	217.00	17.67	12.28
Yamamoto and Hayashi, 2006	10	10 min	PHYS	EXDUR	1013.00	108.00	9.38	986.00	104.00	9.48
Blanchfield et al, 2018	11	20 min	PHYS	RTTE	596.00	148.00	4.03	589.00	216.00	2.73
Petit et al, 2014	16	20 min	PHYS	PP	1023.34	210.90	4.85	1014.44	161.30	6.29
Petit et al, 2014	16	20 min	PHYS	MP	713.36	110.10	6.48	708.86	93.20	7.61
Romdhani et al, 2021	14	20 min	PHYS	PMAX			***			***
Romdhani et al, 2021	14	20 min	PHYS	PMEAN			***			***
Abdessalem et al, 2019	18	25 min	PHYS	TD	724.00	62.00	11.68	697.00	74.00	9.42
Abdessalem et al, 2019	18	25 min	PHYS	HD	134.00	14.00	9.57	126.00	14.00	9.00
Boukhris et al, 2019	17	25 min	PHYS	BD	134.10	13.40	10.01	126.40	13.60	9.29

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Boukhris et al, 2019	17	25 min	PHYS	TD	719.90	65.50	10.99	697.10	74.10	9.41
Boukhris et al, 2022	15	25 min	PHYS	GD	135.00	3.00	45.00	126.00	3.00	42.00
Boukhris et al, 2022	15	25 min	PHYS	TD	720.00	18.00	40.00	694.00	20.00	34.70
Hsouna et al, 2019	20	25 min	PHYS	AS5JT	2.74	0.04	68.50	2.67	0.05	53.40
Hsouna et al, 2020a	12	25 min	PHYS	TD	736.00	16.00	46.00	718.00	15.00	47.87
Hsouna et al, 2020a	12	25 min	PHYS	BD	135.00	4.00	33.75	130.00	3.00	43.33
Daaloul et al, 2019	13	30 min	PHYS	SJ	39.00	5.20	7.50	39.60	4.40	9.00
Daaloul et al, 2019	13	30 min	PHYS	CMJ	42.30	5.20	8.13	42.70	4.20	10.17
Soussi et al, 2020	14	30 min	PHYS	TD	747.00	3.00	249.00	743.00	3.00	247.67
Soussi et al, 2020	14	30 min	PHYS	PD	142.60	1.50	95.07	139.10	1.50	92.73
Tanabe et al, 2020	7	30 min	PHYS	GSRH	47.10	7.30	6.45	47.10	5.80	8.12
Tanabe et al, 2020	7	30 min	PHYS	GSLH	43.70	5.50	7.95	44.60	7.00	6.37
Tanabe et al, 2020	7	30 min	PHYS	BS	143.50	28.30	5.07	141.40	26.90	5.26
Tanabe et al, 2020	7	30 min	PHYS	WTMP	634.90	96.60	6.57	625.00	76.70	8.15
Tanabe et al, 2020	7	30 min	PHYS	WTPP	841.90	139.60	6.03	816.60	91.10	8.96
Boukhris et al, 2019	17	35 min	PHYS	BD	131.10	7.80	16.81	126.40	13.60	9.29
Boukhris et al, 2019	17	35 min	PHYS	TD	720.50	52.20	13.80	697.10	74.10	9.41
Hsouna et al, 2019	20	35 min	PHYS	AS5JT	2.77	0.05	55.40	2.67	0.05	53.40
Hsouna et al, 2020b	14	35 min	PHYS	TD	718.00	14.00	51.29	684.00	20.00	34.20
Hsouna et al, 2020b	14	35 min	PHYS	BD	129.00	2.00	64.50	124.00	3.00	41.33
Boukhris et al, 2020	14	40 min	PHYS	HD	139.00	11.00	12.64	129.00	6.00	21.50
Boukhris et al, 2020	14	40 min	PHYS	TD	759.00	71.00	10.69	704.00	37.00	19.03
Hsouna et al, 2022	12	40 min	PHYS	TD	702.00	11.00	63.82	640.00	10.00	64.00
Hsouna et al, 2022	12	40 min	PHYS	BD	126.00	1.00	126.00	116.00	2.00	58.00
Souabni et al, 2022	12	40 min	PHYS	DA	5.62	0.06	93.67	6.00	0.04	150.00
Souabni et al, 2022	12	40 min	PHYS	OA	8.48	0.08	106.00	8.72	0.14	62.29
Souabni et al, 2022	12	40 min	PHYS	UBP	6.91	0.25	27.64	6.52	0.23	28.35
Souabni et al, 2022	12	40 min	PHYS	SST	87.00	9.00	9.67	86.00	10.00	8.60
Boukhris et al, 2019	17	45 min	PHYS	BD	139.60	15.90	8.78	126.40	13.60	9.29
Boukhris et al, 2019	17	45 min	PHYS	TD	755.10	63.30	11.93	697.10	74.10	9.41
Boukhris et al, 2022	15	45 min	PHYS	GD	140.00	4.00	35.00	126.00	3.00	42.00
Boukhris et al, 2022	15	45 min	PHYS	TD	758.00	14.00	54.14	694.00	20.00	34.70
Hsouna et al, 2019	20	45 min	PHYS	AS5JT	2.78	0.06	46.33	2.67	0.05	53.40
Romyn et al, 2022	12	60 min	PHYS	3MSPL	0.83	0.09	9.22	0.81	0.08	10.13
Romyn et al, 2022	12	60 min	PHYS	5MSPL	1.18	0.09	13.11	1.18	0.07	16.86
Romyn et al, 2022	12	60 min	PHYS	10MSPL	1.98	0.08	24.75	1.97	0.09	21.89
Romyn et al, 2022	12	60 min	PHYS	AGYL	2.45	0.11	22.27	2.47	0.11	22.45
Tanabe et al, 2020	7	60 min	PHYS	GSRH	47.40	7.60	6.24	47.10	5.80	8.12

Tanabe et al, 2020	7	60 min	PHYS	GSLH	43.20	5.80	7.45	44.60	7.00	6.37
Tanabe et al, 2020	7	60 min	PHYS	BS	142.90	24.70	5.79	141.40	26.90	5.26
Tanabe et al, 2020	7	60 min	PHYS	WTMP	625.90	65.90	9.50	625.00	76.70	8.15
Tanabe et al, 2020	7	60 min	PHYS	WTPP	817.30	97.10	8.42	816.60	91.10	8.96
Boukhris et al, 2020	14	90 min	PHYS	HD	142.00	13.00	10.92	129.00	6.00	21.50
Boukhris et al, 2020	14	90 min	PHYS	TD	793.00	64.00	12.39	704.00	37.00	19.03
Romdhani et al, 2021	14	90 min	PHYS	PMAX			***			***
Romdhani et al, 2021	14	90 min	PHYS	PMEAN			***			***
Tanabe et al, 2020	7	90 min	PHYS	GSRH	48.40	6.30	7.68	47.10	5.80	8.12
Tanabe et al, 2020	7	90 min	PHYS	GSLH	45.40	5.10	8.90	44.60	7.00	6.37
Tanabe et al, 2020	7	90 min	PHYS	BS	150.00	27.70	5.42	141.40	26.90	5.26
Tanabe et al, 2020	7	90 min	PHYS	WTMP	628.10	69.00	9.10	625.00	76.70	8.15
Tanabe et al, 2020	7	90 min	PHYS	WTPP	831.90	105.80	7.86	816.60	91.10	8.96
Romyn et al, 2022	12	120 min	PHYS	3MSPL	0.82	0.07	11.71	0.81	0.08	10.13
Romyn et al, 2022	12	120 min	PHYS	5MSPL	1.20	0.08	15.00	1.18	0.07	16.86
Romyn et al, 2022	12	120 min	PHYS	10MSPL	1.99	0.08	24.88	1.97	0.09	21.89
Romyn et al, 2022	12	120 min	PHYS	AGYL	2.48	0.11	22.55	2.47	0.11	22.45
Yamamoto and Hayashi, 2006	10	10 min	FATG	RPE	15.40	1.00	15.40	17.20	0.60	28.67
Blanchfield et al, 2018	11	20 min	FATG	FATGB	2.80	1.80	1.56	2.20	1.90	1.16
Petit et al, 2014	16	20 min	FATG	FI	53.96	8.70	6.20	53.92	7.40	7.29
Abdessalem et al, 2019	18	25 min	FATG	RPE	4.40	1.60	2.75	4.70	1.20	3.92
Boukhris et al, 2019	17	25 min	FATG	FI	13.30	6.00	2.22	11.70	3.20	3.66
Boukhris et al, 2019	17	25 min	FATG	RPE	4.80	1.50	3.20	4.60	1.10	4.18
Boukhris et al, 2022	15	25 min	FATG	FI	13.40	1.60	8.38	11.90	0.90	13.22
Boukhris et al, 2022	15	25 min	FATG	RPE	5.00	0.30	16.67	4.70	0.30	15.67
Hsouna et al, 2019	20	25 min	FATG	FATG	4.05	0.20	20.25	4.50	0.30	15.00
Hsouna et al, 2020a	12	25 min	FATG	FI	12.30	1.40	8.79	11.20	0.90	12.44
Hsouna et al, 2020a	12	25 min	FATG	RPE	4.83	1.31	3.69	4.54	0.73	6.22
Daaloul et al, 2019	13	30 min	FATG	FATG	4.10	1.20	3.42	4.40	0.80	5.50
Soussi et al, 2020	14	30 min	FATG	FI	11.00	0.90	12.22	14.00	0.60	23.33
Boukhris et al, 2019	17	35 min	FATG	FATG	10.50	5.80	1.81*	11.70	3.20	3.66
Boukhris et al, 2019	17	35 min	FATG	RPE	4.60	1.20	3.83	4.60	1.10	4.18
Hsouna et al, 2019	20	35 min	FATG	FATG	3.95	0.28	14.11	4.50	0.30	15.00
Hsouna et al, 2020b	14	35 min	FATG	FI	10.40	1.60	6.50	11.70	0.90	13.00
Hsouna et al, 2020b	14	35 min	FATG	RPE	4.22	0.18	23.44	4.59	0.28	16.39
Boukhris et al, 2020	14	40 min	FATG	FI	12.00	4.00	3.00	15.00	4.00	3.75
Hsouna et al, 2022	12	40 min	FATG	FI	13.60	1.60	8.50	15.00	1.40	10.71
Hsouna et al, 2022	12	40 min	FATG	RPE	4.62	0.17	27.18	5.65	0.19	29.74

Souabni et al, 2022	12	40 min	FATG	FATG	1.00	1.54	0.65**	0.50	1.34	0.37**
Souabni et al, 2022	12	40 min	FATG	RPE	10.30	1.30	7.92	11.00	2.00	5.50
Boukhris et al, 2019	17	45 min	FATG	FI	10.80	2.40	4.50	11.70	3.20	3.66
Boukhris et al, 2019	17	45 min	FATG	RPE	3.70	1.10	3.36	4.60	1.10	4.18
Boukhris et al, 2022	15	45 min	FATG	FI	10.70	0.60	17.83	11.90	0.90	13.22
Boukhris et al, 2022	15	45 min	FATG	RPE	3.90	0.30	13.00	4.70	0.30	15.67
Hsouna et al, 2019	20	45 min	FATG	FATG	3.30	0.33	10.00	4.50	0.30	15.00
Romyn et al, 2022	12	60 min	FATG	PEREX	12.00	2.30	5.22	11.20	2.30	4.87
Boukhris et al, 2020	14	90 min	FATG	FI	10.00	3.00	3.33	15.00	4.00	3.75
Romyn et al, 2022	12	120 min	FATG	PEREX	13.20	1.94	6.80	11.20	2.30	4.87

*Boukhris et al, 2019: FI: The Shapiro–Wilk test revealed that sleep quality, RPE, FI, and BD data were normally distributed.

**Souabni et al, 2022: FATG: The Shapiro–Wilk W-test revealed that ESS, RPE, HR mean, HR peak, SST, Hooper's fatigue and total score were normally distributed.

***Romdhani et al, 2021: The Shapiro–Wilks revealed that data were normally distributed. The authors directly reported the MD (95% CI) between the N20 or N90 and No-Nap groups.

Table S6. Recommendations for future studies on the effect of daytime napping on sport performance and fatigue.

Study Characteristic	Recommendations
Population	Considering gender differences in sleep,[1] in addition to the age-related physiological changes for both sleep and sports practice,[2, 3] it is essential to conduct studies in both genders and at older ages. Furthermore, although sample size calculations were presented in most of the studies, the sample sizes were generally small (between 7 and 20 participants), which has led to an increase in the measures of dispersion (i.e., compatibility interval, standard deviation) and small sample bias.[4] Therefore, it is recommended to use more conservative parameters for sample size calculation, such as those found in the results of this review, ensuring an increase in the statistical power to detect differences. This is particularly important in studies with professional athletes, in whose margin of improvement in sports performance is minimal.
Exposure (napping)	Future studies on this topic should use PSG to assess napping, the gold-standard method for sleep assessment. This would be useful not only to confirm that the participant has slept but also to assess the architecture of the sleep period.[5] In addition, both the timing of the nap (or of the activities in the control group) and its duration are parameters to be noted. The optimal time to assess napping seems to be after lunch and the sports activities in the afternoon or evening. Although the usual time of the available studies was at 2 p.m., it is not reasonable to fix this time as a recommendation because lunch time can vary according to cultural, labor and geographical aspects. Regarding nap duration, it is recommended to evaluate at least two different durations so that it can be assessed whether there is a dose—response effect, in addition to a ceiling effect (i.e., a limit from which to increase the duration of the nap does not lead to additional benefits).
Outcomes (sport performance)	In addition to considering the most appropriate tests for this purpose in each sport modality, it would be useful for future meta-analyses to also measure performance according to frequently used tests, such as the 5-m shuttle run test for physical performance, the digital cancellation test to measure cognitive performance, and the fatigue index to measure perceived fatigue. Specifically, this would allow calculation of the nonstandardized effect of napping on each of these indicators of sports performance, so that more easily interpretable and practically applicable measures would be available.
Study design	The crossover controlled clinical trial with randomization of intervention (nap, no nap) has been the most commonly used design thus far, with a washout time ranging from 1 to 7 days. Considering that circadian rhythm dynamics, sleep needs and sports training rhythm may vary according to the day of the week, a 7-day washout time is recommended in order to minimize the impact of these variations on the results. On the other hand, considering what was observed in the meta-regression on the effect of the time between the awakening from the nap and the sports activity on the results, it seems that 60 minutes is the minimum time necessary to overcome the feeling of sleep inertia before the test.
Other recommendations	Despite the increase in costs and methodological complexity, repeating the two phases of the experiment once or twice with the same participants would make it possible to control the effect of intraindividual variability, enhancing the robustness of the findings. Finally, considering the predominance of studies coming from the same country, Tunisia, it is also advisable to carry out studies on this subject in other countries with different geographical positions, habits and customs to broaden and reinforce the generalization of the findings.

References cited in this table: (1) Krishnan V, Collop NA. Gender differences in sleep disorders. Curr Opin Pulm Med 2006;12(6):383-9. (2).Cameron AFM, Perera N, Fulcher M. Professional Athletes Have Poorer Sleep Quality and Sleep Hygiene Compared With an Age-Matched Cohort. Clin J Sport Med 2021;31(6):488-493. (3) Mander BA, Winer JR, Walker MP. Sleep and Human Aging. Neuron 2017;94(1):19-36. (4) Lin L. Bias caused by sampling error in meta-analysis with small sample sizes. PLoS One 2018;13(9):e0204056. (5) Rundo JV, Downey R, 3rd. Polysomnography. Handb Clin Neurol 2019;160:381-392.

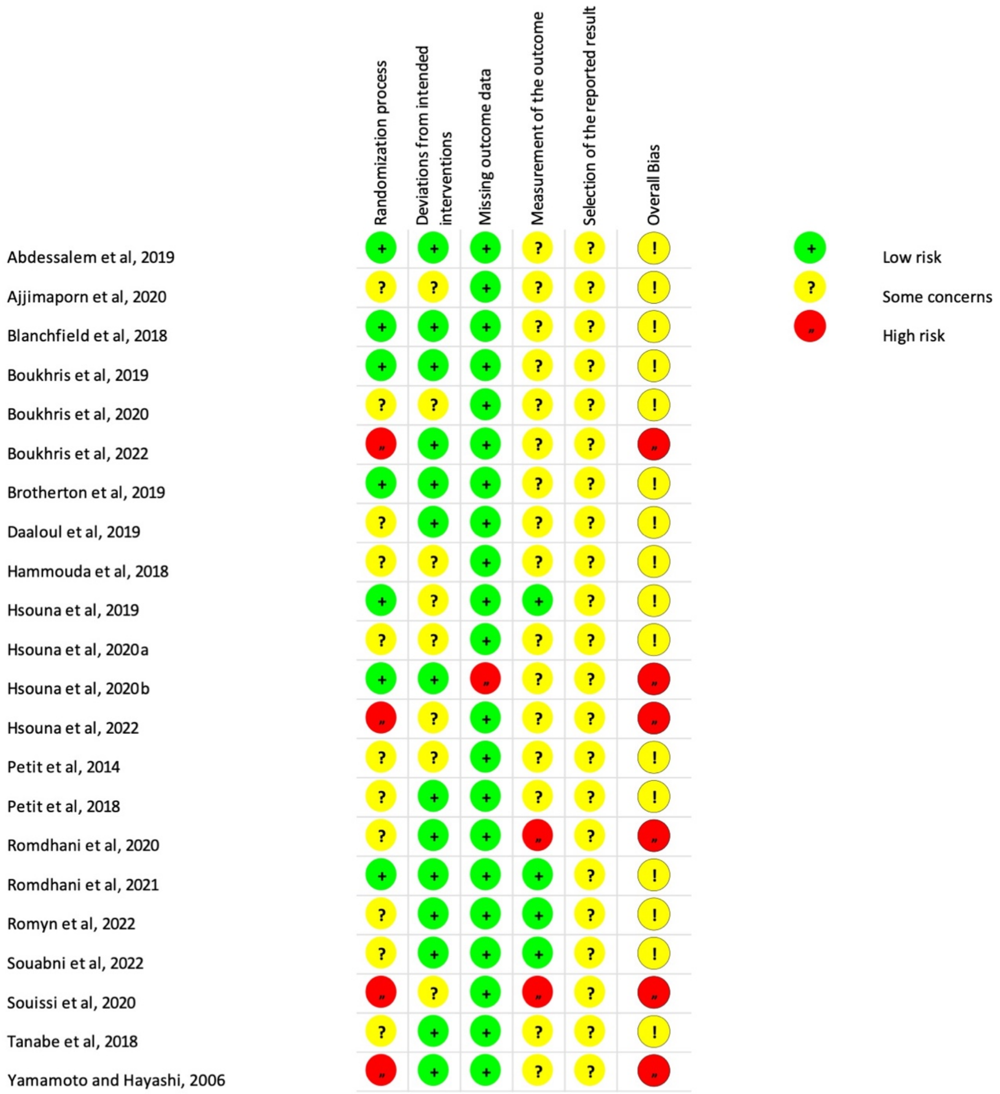
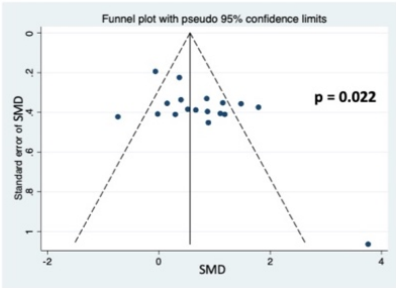


Figure S1. Risk of bias assessment.

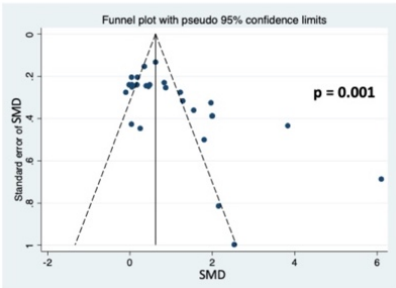
Cognitive performance

Normal Sleep



Physical performance

Normal Sleep



Fatigue

Normal Sleep

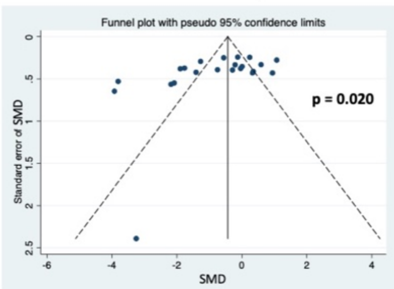


Figure S2. Publication bias in normal sleep.

Cognitive performance

Normal Sleep

Study omitted	Estimate	[95% Conf.	Interval]
Petit et al, 2018	.74375463	.43189207	1.0556172
Romdhani et al, 2021	.65924382	.33477163	.9837159
Abdessalem et al, 2019	.70954275	.37671140	1.0423741
Hsouna et al, 2019	.67925209	.34775278	1.0107514
Hsouna et al, 2020a	.72851104	.40435207	1.0526700
Daaloul et al, 2019	.72314674	.39456719	1.0517263
Soussi et al, 2020	.62997383	.33532870	.9246189
Tanabe et al, 2020	.66482997	.33993813	.9897217
Hsouna et al, 2019	.63504827	.32216755	.9479289
Hsouna et al, 2020b	.66002733	.33676821	.9832864
Boukhris et al, 2020	.70042694	.36952978	1.0313241
Hsouna et al, 2019	.61296946	.31379557	.9121433
Romyn et al, 2022	.71205842	.38344508	1.0406718
Tanabe et al, 2020	.67885143	.35208920	1.0056137
Boukhris et al, 2020	.69182670	.36128178	1.0223715
Romdhani et al, 2021	.71725148	.37500557	1.0594975
Tanabe et al, 2020	.67896575	.35034215	1.0075893
Romyn et al, 2022	.75798857	.45611396	1.0598632
Combined	.68762623	.37451298	1.0007395

Partial Sleep Deprivation

Study omitted	Estimate	[95% Conf.	Interval]
Daaloul et al, 2019	1.7354630	-.14201489	3.6129410
Soussi et al, 2020	.3693747	-.17604518	.9147946
Romdhani et al, 2020	1.6651227	-.01844214	3.3486876
Brotherton et al, 2019	2.0491927	-.48078853	4.5791740
Ajjimapor et al, 2020	2.2384744	.04248931	4.4344597
Romdhani et al, 2020	1.6874781	-.00635041	3.3813064
Combined	1.6090756	.05431541	3.1638359

Physical performance

Normal Sleep

Study omitted	Estimate	[95% Conf.	Interval]
Petit et al, 2014	1.0320410	.70488846	1.3591934
Blanchfield et al, 2018	1.0247973	.70049113	1.3491036
Romdhani et al, 2021	1.0217937	.67538100	1.3682064
Hsouna et al, 2020a	.9794117	.65431225	1.3045112
Boukhris et al, 2022	.9641198	.64464748	1.2835922
Abdessalem et al, 2019	1.0167698	.68566346	1.3478761
Boukhris et al, 2019	1.0175594	.68699753	1.3481213
Hsouna et al, 2019	.9679903	.64554816	1.2904325
Daaloul et al, 2019	1.0358577	.71103311	1.3606822
Tanabe et al, 2020	1.0325074	.70509303	1.3599217
Soussi et al, 2020	.9624084	.64158291	1.2832341
Boukhris et al, 2019	1.0199052	.68944550	1.3503649
Hsouna et al, 2020b	.9456805	.62953216	1.2618290
Hsouna et al, 2019	.9484421	.63066304	1.2662213
Hsouna et al, 2022	.8373625	.55931026	1.1154149
Souabni et al, 2022	.9629048	.64443702	1.2813727
Boukhris et al, 2020	1.0021118	.67066705	1.3335567
Hsouna et al, 2019	.9489352	.63102049	1.2668500
Boukhris et al, 2022	.8634183	.57635587	1.1504809
Boukhris et al, 2019	.9994243	.66951174	1.3293370
Romyn et al, 2022	1.0344927	.70618445	1.3628010
Tanabe et al, 2020	1.0347646	.70838070	1.3611486
Romdhani et al, 2021	1.0288820	.68993306	1.3678309
Tanabe et al, 2020	1.0284348	.69953680	1.3573327
Boukhris et al, 2020	.9821641	.65587354	1.3084548
Romyn et al, 2022	1.0300840	.69930989	1.3608581
Yamamoto and Hayashi, 2006	1.0170815	.69231588	1.3418471
Combined	.9897622	.67263974	1.3068847

Partial Sleep Deprivation

Study omitted	Estimate	[95% Conf.	Interval]
Daaloul et al, 2019	1.0224391	.58049077	1.4643874
Soussi et al, 2020	.8159581	.41166955	1.2202467
Hammouda et al, 2018	1.0128356	.46149281	1.5641783
Romdhani et al, 2020	.9600330	.50722873	1.4128373
Brotherton et al, 2019	1.0433085	.57561189	1.5110050
Ajjimapor et al, 2020	.7827507	.39615786	1.1693436
Hammouda et al, 2018	.8639219	.43599799	1.2918459
Romdhani et al, 2020	.8091117	.40931210	1.2089113
Combined	.9106002	.50631926	1.3148812

Fatigue

Normal Sleep

Study omitted	Estimate	[95% Conf.	Interval]
Blanchfield et al, 2018	-.81146365	-1.3101766	-.3127507
Petit et al, 2014	-.79953253	-1.3044534	-.2946116
Abdessalem et al, 2019	-.78974807	-1.2975810	-.2819151
Boukhris et al, 2019	-.81524789	-1.3240739	-.3064218
Boukhris et al, 2022	-.84747899	-1.3201568	-.3748010
Hsouna et al, 2019	-.70488858	-1.1938279	-.2159492
Hsouna et al, 2020a	-.82733893	-1.3232582	-.3314198
Daaloul et al, 2019	-.78379631	-1.2879726	-.2796200
Soussi et al, 2020	-.61992872	-1.0789969	-.1608605
Boukhris et al, 2019	-.79809701	-1.3160161	-.2801779
Hsouna et al, 2019	-.69758785	-1.1834369	-.2117388
Hsouna et al, 2020b	-.73257267	-1.2339967	-.2311487
Boukhris et al, 2020	-.76081687	-1.2645259	-.2571078
Hsouna et al, 2022	-.73503566	-1.2190797	-.2509915
Souabni et al, 2022	-.79648465	-1.3004365	-.2925328
Boukhris et al, 2019	-.77520263	-1.2935959	-.2568092
Boukhris et al, 2022	-.69704443	-1.1844063	-.2096826
Hsouna et al, 2019	-.60600066	-1.0517306	-.1602707
Romyn et al, 2022	-.81327611	-1.3121651	-.3143871
Boukhris et al, 2020	-.72630799	-1.2224993	-.2301167
Romyn et al, 2022	-.83827037	-1.3277739	-.3487668
Yamamoto and Hayashi, 2006	-.69311404	-1.1793623	-.20686577
Combined	-.75734408	-1.2394554	-.2752327

Partial Sleep Deprivation

Study omitted	Estimate	[95% Conf.	Interval]
Daaloul et al, 2019	-1.0607325	-2.0797985	-.04166658
Soussi et al, 2020	-.3623781	-.6456733	-.07908299
Brotherton et al, 2019	-1.1693966	-2.3467412	.00794795
Romdhani et al, 2020	-1.1461543	-2.1260092	-.16629930
Romdhani et al, 2020	-.9890058	-1.9593190	-.01869280
Ajjimapor et al, 2020	-1.2085466	-2.2654343	-.15165907
Combined	-.96317668	-1.7961013	-.13025202

Figure S3. Sensitivity analyses in normal sleep and partial sleep-deprived conditions.

Mesas AE, *et al. Br J Sports Med* 2023;0:1–11. doi: 10.1136/bjsports-2022-106355

Meta-Regression

For studies in a normal sleep condition, random effects (Sidik-Jonkman method) meta-regression models were used to examine whether trial-level covariates (mean age of participants – ranging from 18.3 to 35.0 years—, nap duration – ranging from 10 to 120 –, and time from nap awakening to test – ranging from 15 to 270 min) influenced heterogeneity.

Meta-regression was not performed with studies in a partial sleep deprivation condition because this method is not recommended when fewer than 10 studies are available.

Because of the small number of studies, multivariate meta-regression models were not recommended. Thus, univariate meta-regression models were estimated, as with any linear regression model, to estimate the proportion of between-trial heterogeneity explained by the model, as well as the change in the effect size estimate for each 1-unit change in the characteristic included as a predictor in the model.

The variability explained by each model was tested using the Wald test, and residual heterogeneity estimates (τ, τ^2, I^2, H^2) were also calculated for each model. The normality assumption for meta-regression was checked using bubble plots and residual value Q-Q, as presented in the following pages.

Outcome: **Cognitive performance**

Covariate: age (years)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	0.722	1	0.396
Test of Residual Heterogeneity	59.727	16	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

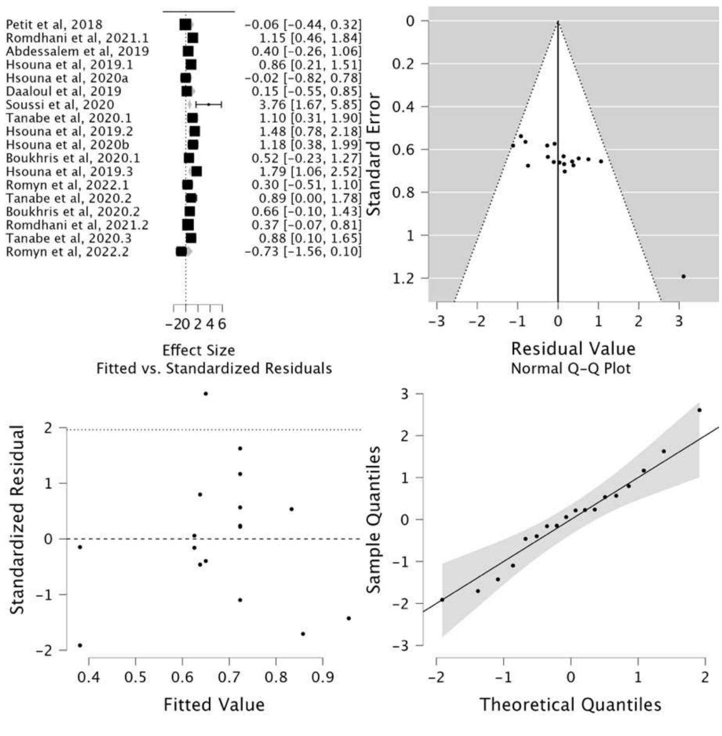
	Estimate	Standard Error	z	p
intercept	-1.855	2.999	-0.619	0.536
edadcont	0.122	0.144	0.850	0.396

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	0.318
τ	0.564
I^2 (%)	71.599
H^2	3.521

Diagnostic Plots



Covariate: nap duration (min)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	1.705	1	0.192
Test of Residual Heterogeneity	58.534	16	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

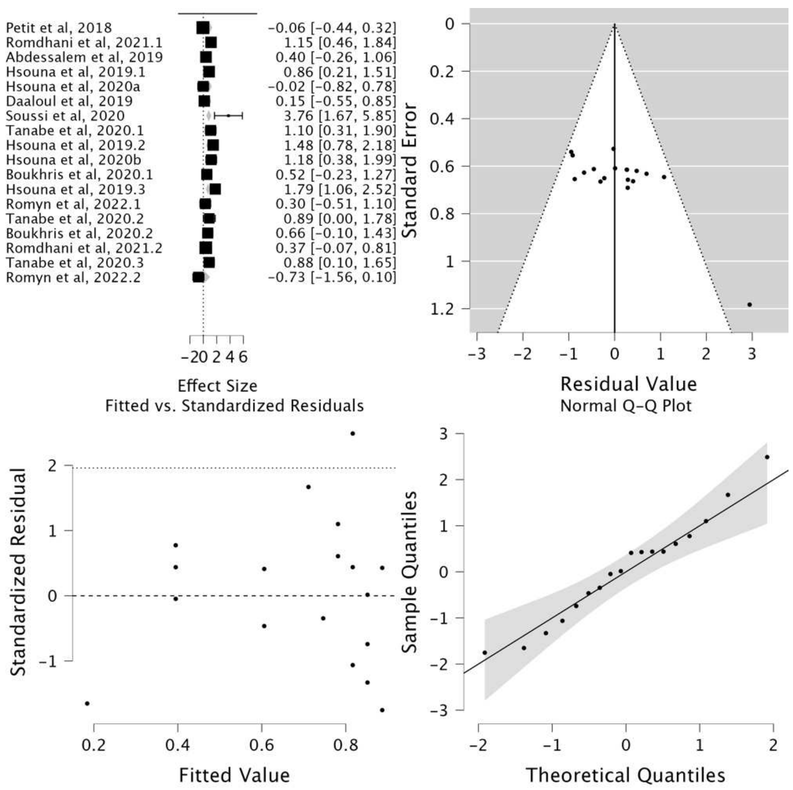
	Estimate	Standard Error	z	p
intercept	1.027	0.305	3.366	< .001
napdur	-0.007	0.005	-1.306	0.192

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	0.302
τ	0.550
I^2 (%)	70.333
H^2	3.371

Diagnostic Plots



Covariate: time from nap awakening to test (min)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	4.063	1	0.044
Test of Residual Heterogeneity	56.042	16	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

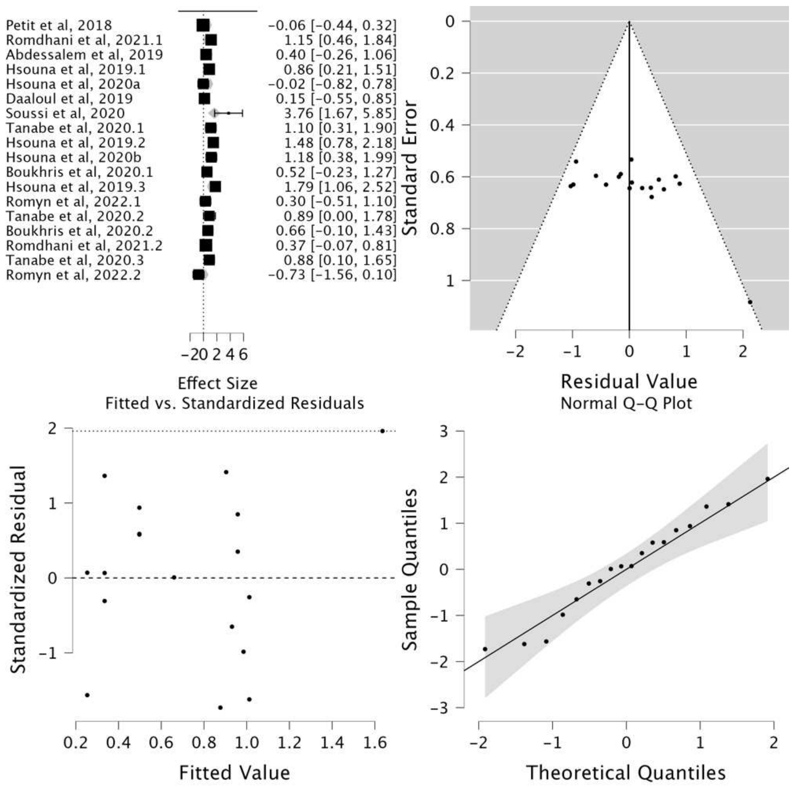
	Estimate	Standard Error	z	p
intercept	0.172	0.299	0.576	0.564
washout	0.005	0.003	2.016	0.044

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	0.289
τ	0.537
I^2 (%)	69.760
H^2	3.307

Diagnostic Plots



Outcome: **Physical performance**
Covariate: age (years)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	0.023	1	0.880
Test of Residual Heterogeneity	238.659	25	< .001

Note. *p* -values are approximate.
Note. The model was estimated using Restricted ML method.

Coefficients

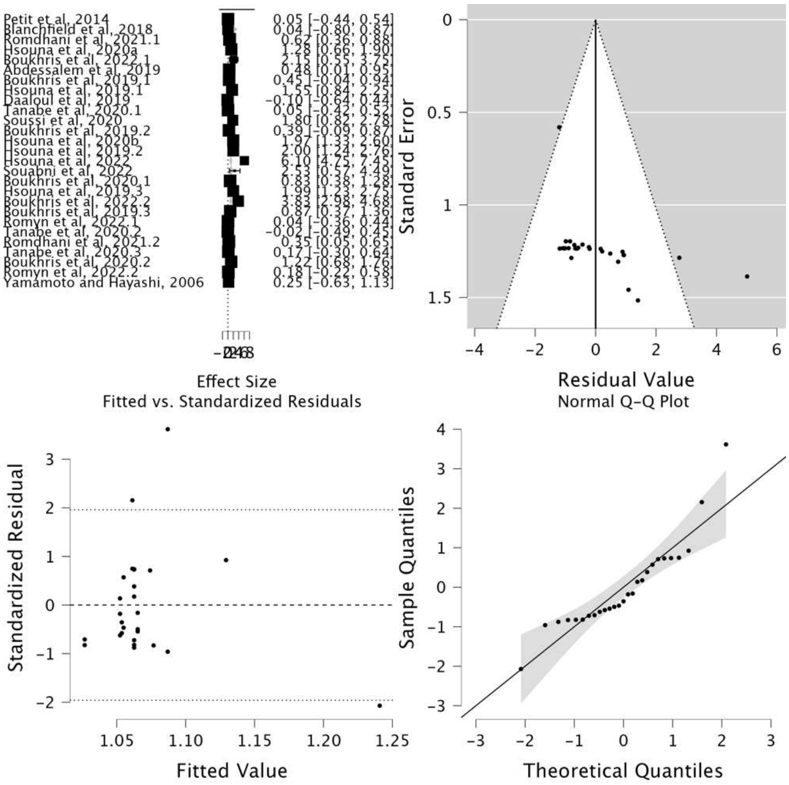
	Estimate	Standard Error	z	p
intercept	0.792	1.850	0.428	0.668
edadcont	0.013	0.085	0.151	0.880

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	1.528
τ	1.236
I^2 (%)	95.620
H^2	22.832

Diagnostic Plots



Covariate: nap duration (min)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	0.320	1	0.572
Test of Residual Heterogeneity	232.809	25	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

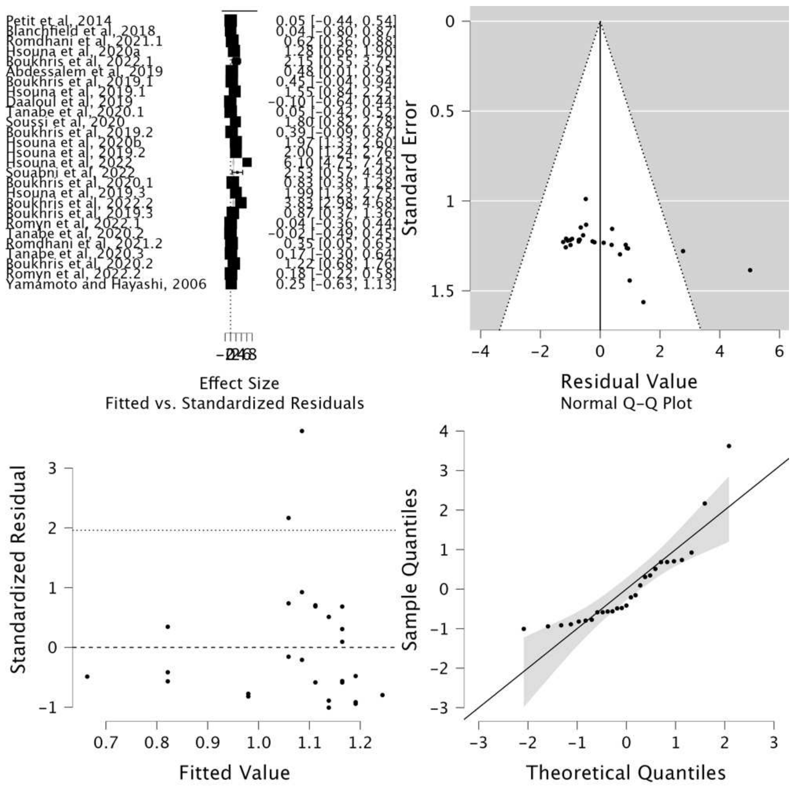
	Estimate	Standard Error	z	p
intercept	1.296	0.474	2.733	0.006
napdur	-0.005	0.009	-0.565	0.572

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	1.510
τ	1.229
I^2 (%)	95.345
H^2	21.480

Diagnostic Plots



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Covariate: time from nap awakening to test (min)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	8.241	1	0.004
Test of Residual Heterogeneity	183.417	25	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

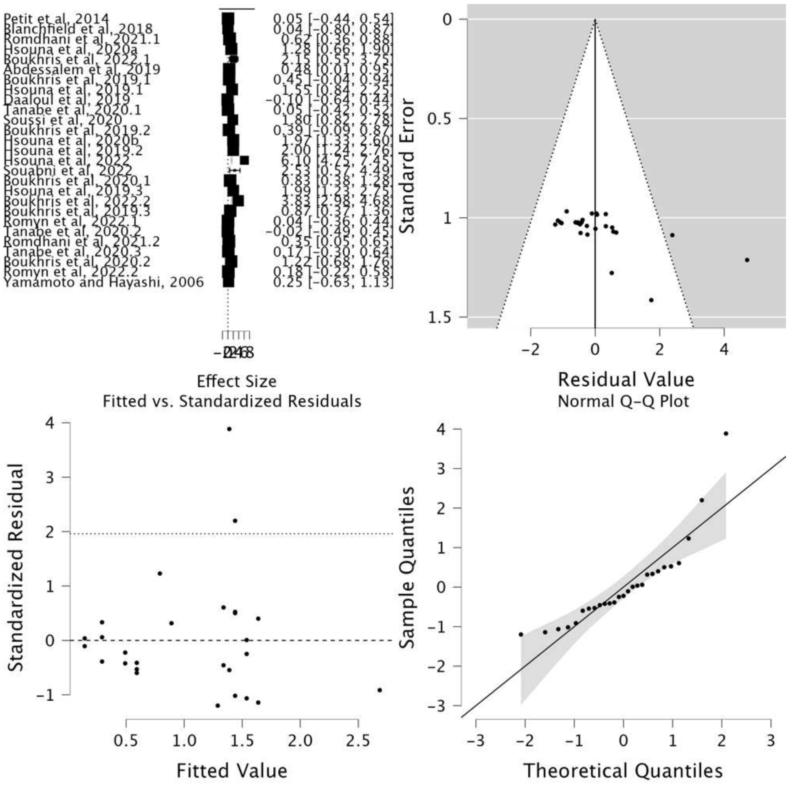
	Estimate	Standard Error	z	p
intercept	-0.006	0.422	-0.015	0.988
washout	0.010	0.003	2.871	0.004

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	1.058
τ	1.029
I^2 (%)	93.601
H^2	15.628

Diagnostic Plots



Outcome: **Fatigue**

Covariate: age (years)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	0.487	1	0.485
Test of Residual Heterogeneity	197.668	20	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

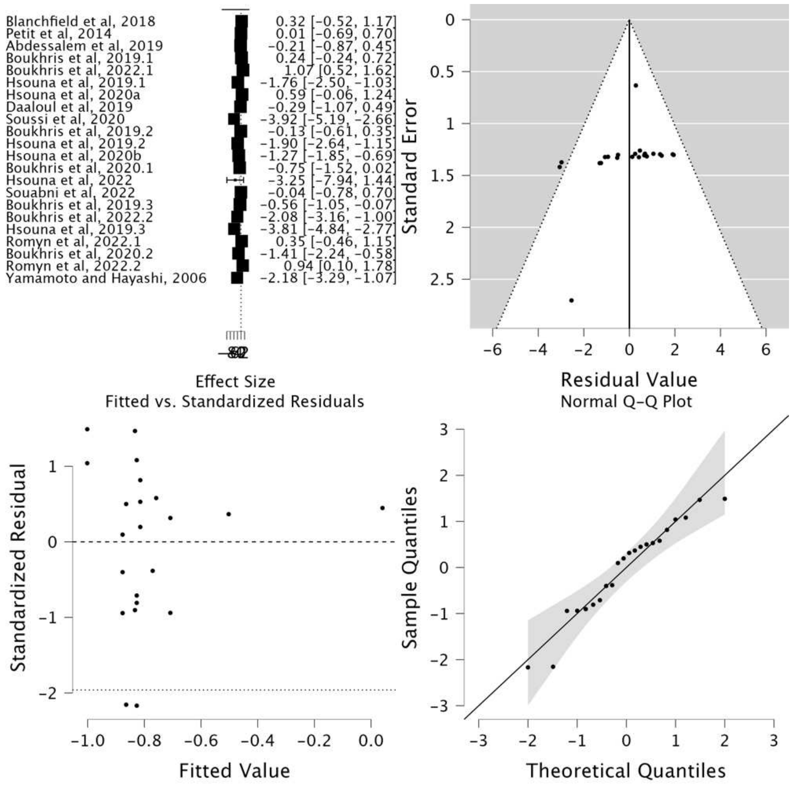
	Estimate	Standard Error	z	p
intercept	-2.143	1.970	-1.088	0.277
edadcont	0.062	0.089	0.698	0.485

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	1.697
τ	1.303
I^2 (%)	92.856
H^2	13.997

Diagnostic Plots



Mesas AE, *et al. Br J Sports Med* 2023;0:1–11. doi: 10.1136/bjsports-2022-106355

Covariate: nap duration (min)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	0.250	1	0.617
Test of Residual Heterogeneity	199.523	20	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

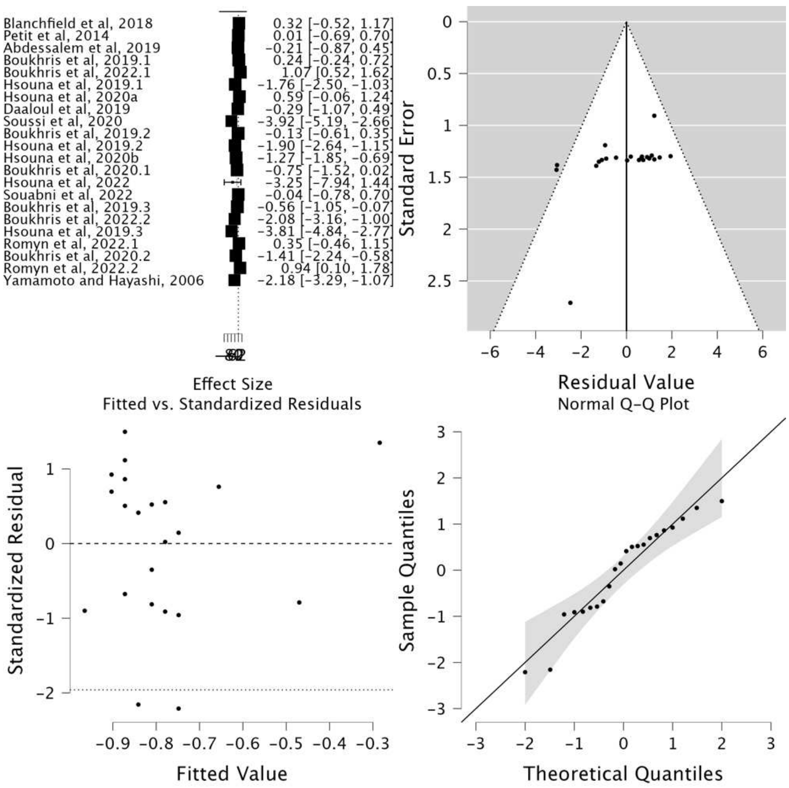
	Estimate	Standard Error	z	p
intercept	-1.027	0.569	-1.803	0.071
napdur	0.006	0.012	0.500	0.617

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	1.725
τ	1.313
I^2 (%)	92.938
H^2	14.160

Diagnostic Plots



Mesas AE, *et al. Br J Sports Med* 2023;0:1–11. doi: 10.1136/bjsports-2022-106355

Covariate: time from nap awakening to test (min)

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	3.854	1	0.050
Test of Residual Heterogeneity	191.116	20	< .001

Note. *p* -values are approximate.

Note. The model was estimated using Restricted ML method.

Coefficients

	Estimate	Standard Error	z	p
intercept	0.334	0.628	0.532	0.595
washout	-0.009	0.005	-1.963	0.050

Note. Wald test.

Residual Heterogeneity Estimates

	Estimate
τ^2	1.452
τ	1.205
I^2 (%)	91.718
H^2	12.074

Diagnostic Plots