
Supplementary information

Desynchronizing the sleep–wake cycle from circadian timing to assess their separate contributions to physiology and behaviour and to estimate intrinsic circadian period

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Supplementary Table 1: FD protocols parameters and outcome measures of studies cited in the manuscript.

Study	T-cycle	Sleep:Wake duration	Sleep:Wake ratio	FD segment duration (24-hour days)	Participants	Outcome measurements
Kleitman 1939	28-hour	9:19	1:2	32 days	2M	Core body temperature
Aschoff 1967	24-hour 24-hour 24-hour	12:12 6:18 18:6	1:1 1:3 1:0.33	21 days 1 day 1 day	2M	Core body temperature
Aschoff 1969	26.7-hour	9:17.7	1:2	14 days	4	Core body temperature
Weitzman 1974	3-hour	1:2	1:2	10 days	7 (6M, 1F)	Core body temperature, plasma cortisol, growth hormone, sleep stages
Carskadon 1975	90-minute	30:60	1:2	5 days	5 (3M, 2F)	Sleep stages
Mills 1977	21-hour 27-hour	7:14 9:18	1:2 1:2	7-14 days 9 days	14 (10M, 4F) 11 (8M, 3F)	Core body temperature, urine
Moses 1978	220-minute	60:160	1:2.7	40 hours	8 (7M, 1F)	Sleep stages
	90-minute	30:60	1:2	5 days	10 (6M, 4F)	Sleep stages
	3-hour	1:2	1:2	10 days	7 (6M, 1F)	Sleep stages
Lavie 1981	20-minute	5:15	1:3	12 hours	9 (4M, 5F)	Sleep stages
Lavie 1986	20-minute	7:13	1:2	24 hours	14	Sleep stages
	20-minute	7:13	1:2	36 hours	8M	
Czeisler 1986	27-hour	8:19	1:2.4	2 weeks	1F	Core body temperature
Johnson 1992	28-hour	9.33:18.67	1:2	30 days	9M	Core body temperature, performance, alertness, memory
Dijk 1992	28-hour	9.33:18.67	1:2	30 days	9M	Core body temperature, subjective alertness, cognitive performance
Shanahan 1995	20-hour	6.67:13.33	1:2	21 days	1M	Core body temperature, melatonin
	28-hour	9.33:18.67	1:2		13M	
Dijk 1995	28-hour	9.33:18.67	1:2	24 days	8M	Sleep stages
Boivin 1997	28-hour	9.33:18.67	1:2	24 days	10M	Mood
	30-hour	10:20	1:2	16 days	14 (6M, 8F)	Mood
Haimov 1997	20-minute	7:13	1:2	24 hours	25M	Sleep propensity
Hiddinga 1997	20-hour	6.5:13.5	1:2	120 hours	12M	Core body temperature
Akerstedt 1998	4-hour irregular sleep	1:3	1:3	9 days	8M	Sleep stages

Klerman 1998	28-hour	9.33:18.67	1:2	24 days	15 blind people	Core body temperature, plasma melatonin
Waterhouse 1998	27-hour 30-hour	9:18 10:20	1:2 1:2	20 days 14 days	6 6	Core body temperature
Carskadon 1999	28-hour	11.67:16.33	1:1.4	14 days	10 (5M, 5F) adolescents	Salivary melatonin
Czeisler 1999	28-hour	9.33:18.67	1:2	3.5 weeks	24 (20M, 4F)	Core body temperature, plasma melatonin, cortisol
Dijk 1999, 2001	28-hour	9.33:18.67	1:2	24-29 days	24 (20M, 4F)	Core body temperature, melatonin, sleep
Wyatt 1999	20-hour	6.67:13.33	1:2	12-20 days	6 (5M, 1F)	Core body temperature, performance, alertness, memory
Strijkstra 1999	20-hour	10:10	1:1	5 days	8M rats	Core body temperature
Duffy 2001	20-hour 28-hour	6.37:13.33, 9.33:18.67	1:2 1:2	21-28 days	17M	Core body temperature, morningness-eveningness
Wright 2001	28-hour	9.33:18.67	1:2 1:2 1:2	12 days	12 (9M, 3F)	Core body temperature, melatonin
Wright 2002	28-hour	9.33:18.67	1:2	14 days	14 (11M, 3F)	Core body temperature, performance, alertness
Cajochen 2002	42.85-hour	14.28:28.57	1:2	25 days	7M	Sleep EEG
Koorengevel 2003	20-hour	6.50:13.50	1:2	5 days	15 (2M, 13F)	Melatonin, core body temperature, mood, sleep
Wyatt 2004	42.85-hour	14.28:28.57	1:2	25 days	16M	Core body temperature, performance, alertness
Kripke 2005	90-minute	30:60	1:2	72 hours	87	Saliva, urine, oral temperature
Munch 2005	225-minute	75:150	1:2	40 hours	32 (16M, 16F)	Salivary melatonin, subjective sleepiness, sleep EEG
Wright 2005	28-hour	9.33:18.67	1:2	14 days	15 (12M, 3F)	Melatonin
Wyatt 2006	20-hour	6.67:13.33	1:2	20 days	36 (21M, 15F)	Core body temperature, plasma melatonin, sleep
Cain 2007	20-hour	6.67:13.33	1:2	40 days	8M	Core body temperature, plasma melatonin

Hull 2007	28-hour	9.33:18.67	1:2	28 days	7M (blind)	Urinary 6-sulfatoxymelatonin
Gronfier 2007	28-hour	9.33:18.67	1:2	14 days	12 (9M, 3F)	Core body temperature, plasma melatonin
Scheer 2007	28-hour	9.33:18.67	1:2	14 days	7M	Plasma melatonin, plasma cortisol, core body temperature
Scheer 2008	28-hour	9.33:18.67	1:2	8 days	12 (7M, 5F)	Core body temperature, cognitive function
Silva 2008	20-hour	6.67:13.33	1:2	15 days	10 (5M, 5F)	Core body temperature, cognitive function
Lee 2009	28-hour	9.33:18.67	1:2	42 days	11 (9M, 2F)	Core body temperature, performance
O'Donnell 2009	20-hour	6.67:13.33	1:2	26 days	24 (11M, 13F) older	Core body temperature, sleep stages, subjective sleepiness
Scheer 2009	28-hour	9.33:18.67	1:2	8 days	10 (5M, 5F)	Core body temperature, metabolic, blood pressure, autonomic, endocrine function
Scheer 2010	20-hour	6.67:13.33	1:2	10 days	12 (6M, 6F)	Heart rate, cardiovascular function
Cohen 2010	42.85-hour	10:32.85	1:3.3	21 days	9 (5M, 4F)	Melatonin, core body temperature, performance, sleepiness, sleep
Grady 2010	42.85-hour	14.28:28.57	1:2	25 days	19 (11M, 8F)	Core body temperature, performance
Münch 2010	20-hour	6.67:13.33	1:2	12 days	24 (11M, 13F)	Core body temperature, plasma melatonin, sleep stages, sleep, spectral analysis
Silva 2010	20-hour	6.67:13.33	1:2	15 days	20 (10M, 10F)	Core body temperature, performance, cognitive throughput, subjective sleepiness
Yasenkov 2010	4-hour	2:2	1:1	48 hours	8M rats	Sleep, slow wave activity
Duffy 2011a	20-hour	6.67:13.33	1:2	10 days	4 (3M, 1F)	Core body temperature, sleep

						stages, periodic leg movements
Duffy 2011b	11-hour 20-hour 28-hour 42.85 hour	3.67:7.33 6.67:13.33 9.33:18.67 14.28:28.57	1:2 1:2 1:2 1:2	14-43 days	1 26 114 16 Total: 157 (108M, 52F)	Melatonin, core body temperature
Chang 2011	28-hour	9.33:18.67	1:2	3.5 weeks	35	Core body temperature, melatonin, Gene Polymorphism
Buxton 2012	28-hour	6.53:21.47	1:3.3	3 weeks	21 (11M, 10F)	Metabolic measurements
Eastman 2012	4-hour	1.5:2.5	1:1.7	3 days	94 (45M, 49)	Salivary melatonin
Hasan 2012	28-hour	9.33:18.67	1:2	8 days	36 (17M, 19F)	Plasma melatonin, fibroblast measurements
Pomplun 2012	28-hour	6.53:21.47	1:3.3	21 days	12 (6M, 6F)	Core body temperature, cognitive function
Kitamura 2012	28-hour	9.33:18.67	1:2	8 days	23 (19M, 4F)	Melatonin
Wotus 2013	22-hour	11:11	1:1	1-2 months	adult male rats	Plasma corticosterone
Lazar 2013	28-hour	9.33:18.67	1:2	8 days	35 (17M, 18F)	Melatonin, sleep
Archer 2014	28-hour	9.33:18.67	1:2	8 days	22 (11M, 11F)	Melatonin, transcriptome data
Wu 2015	28-hour	11.67:16.33	1:1.4	2 weeks	27 (11M, 16F) adolescents	Melatonin, sleep, performance
Burke 2015	28-hour	9.33:18.67	1:2	Two times 14 days	6 (5M, 1F)	Core body temperature, cognitive performance, subjective sleepiness
Eastman 2015	5-hour	2:3	1:1.5	3 days	36 (19M, 17F)	Salivary melatonin
Ben-Hamo 2016	22-hour	11:11	1:1	3 weeks	adult male rats	Performance, depression
Eastman 2016	5-hour	2:3	1:1.5	3 days	45 (22M, 23F)	Salivary melatonin
Micic 2016	60-minute	20:40	1:2	80 hours	48 (30M, 18F)	Core body temperature, salivary melatonin
Santhi 2016	28-hour	9.33:18.67	1:2	8 days	34 (16M, 18F)	Sleep and wake cognition
Lee 2016	22-hour	11:11	1:1	14 days	Male rats	Sleep, memory
Eastman 2017	5-hour	2:3	1:1.5	3 days	63 (31M, 32F)	Salivary melatonin
Swanson 2017	28-hour	6.53:21.47	1:3.3	3 weeks	10M	Bone biomarkers
Walsh 2017	28-hour	6.53:21.47 9.33:18.67	1:3.3 1:2	2 weeks	24 (12M, 12F)	Sleep stage, under-mattress bed sensor
Crowley 2018	4-hour	2:2	1:1	3 days	88 (44M, 44F)	Salivary melatonin

					adults and adolescents	
Kantermann 2018	5-hour	2:3	1:1.5	3 days	18 (10M, 8F)	Melatonin
McHill 2018	20-hour	6.67:13.33 4.67:15.33	1:2 1:3.3	20 days	17 (10M, 7F)	Cognitive performance
Zitting 2018a	28-hour	6.53:21.47	1:3.3	3 weeks	24 (12M, 12F)	Core body temperature, slow eye movements, performance, sleep
Zitting 2018b	28-hour	11.67:16.33	1:1.4	3 weeks	7 (3M, 4F)	Core body temperature, resting energy expenditure
Chang 2019	28-hour 42.85-hour	9.33:18.67 14.28:28.57	1:2	2-3 weeks	196 (126M, 70F)	Genetic variant in Per2, body temperature, melatonin
McHill 2019	20-hour 20-hour 42.85-hour	6.67:13.33 4.67:15.33 10:32.85	1:2 1:3.3 1:3.3	20 days 21 days	17 (7M, 10F) 9 (5M, 4F)	Melatonin, cognitive function
Yuan 2020	28-hour	6.53:21.47 11.67:16.33	1:3.3 1:1.4	3 weeks	24 (9M, 15F)	Core body temperature, triglycerides, cholesterol, high density lipoprotein, low density lipoprotein
Qian 2020	20-hour	6.67:13.33	1:2	10 days	12 (6M, 6F)	Core body temperature, blood pressure after exercise
Chellappa 2021	28-hour	9.33:18.67	1:2	16 days	19	Metabolic measures
Scheer 2021	28-hour	9.33:18.67	1:2	8 days	18 (9M, 9F)	Core body temperature, pulmonary function, airways resistance, rescue inhaler medication use
Micic 2021	60-minute	20:40	1:2	80 hours	40 (30M, 10F)	Core body temperature, salivary melatonin
Chellappa 2022	28-hour	9.33:18.67	1:2	5 days	6 (4M, 2F)	Oral microbiota
Zitting 2022	28-hour	11.67:16.33	1:1.4	3 weeks	9 (4M, 5F)	Glucose and insulin