

Supplemental Digital Content

Overview of characteristics and main findings of included studies on exercise performance over the menstrual cycle

Reference	Participants			Exclusion Criteria	Method of MC verification	Ovulation criteria	Test day of MC	Hormone level		Main findings
	No.	Age/Height/Body Mass	Activity Level/Health Status					Estradiol pmol/L	Progesterone nmol/L	
Bandyopadhyay & Dalui, 2012 (24)	45	23.4±2.5 yrs 163±4.3 cm 55.3±3.3 kg	Sedentary Healthy Regular MC (28-30 days) Non-smokers	Medication	Counting days BBT	Rise in BBT of 0.4 to 0.6°F	M - day 3 FP - day 10 LP - day 20-24	Not measured	Not measured	VO _{2max} , HR _{peak} , Endurance capacity: M < FP & LP
Cook et al., 2018 (14)	22	21.0±1.1 yrs 169±0.05 cm 66.9±4.7 kg	Athletes (> 2 yrs resistance training) Healthy	OC use in last 6 months Medication Injuries	Counting days	None reported	Day 1 Day 14 Day 21	Not measured	Not measured	Cycling peak power under post-activation potentiation: Day 14 > Day 7 & Day 21
Dos Santos Andrade et al., 2017 (15)	26	21.3±5.5 yrs 166.1±7.1 cm 62.2±7.4 kg	Active soccer players (7-15 hr/wk, > 3 yrs) Regular MC (26-32 days) Nulliparous	OC or female hormone use in last 6 months Knee injuries	Counting days	None reported	FP LP Days not specified	Not measured	Not measured	Hamstring-to-quadriceps peak torque ratio: FP < LP for non-dominant limb No difference for dominant limb
Fazil et al., 2010 (12)	80	17.3±3.1 yrs 165±0.05 cm 59.7±6.1 kg & 17.3±0.7 yrs 164±0.04 cm 57.7±6.9 kg	40 athletes & 40 non-athletes Healthy Regular MC	OC use	Counting days	None reported	Day 1-6 Day 7-12 Day 26-28	Not measured	Not measured	Vertical jump, Reaction time, Hand grip strength, 20m sprint: No difference
Forsyth & Reilly, 2008 (28)	10	33±7.1 yrs 171±5 cm 67.9±10.5 kg	Habitually active Healthy Regular MC	OC use in last 6 months Medication Injuries	Counting days BBT Urinary LH Serum E & P	No E & P limits set, mentions normal range per Landgren, 1980	FP - day 6-10 LP - 6-10 days after LH surge	FP 221.1±95.0 LP 549.0±143.6	FP 2.8±1.7 LP 37.1±9.5	2000 m rowing performance: No difference VO _{2max} , Power output and VO ₂ at 4mM lactate: FP < LP

Girija & Veeraiah, 2011 (7)	40	18-22 yrs	Healthy Regular MC	Cardio-pulmonary disease, weakness or debility	Serial follicular scanning Counting days	Phase confirmed by follicular scanning	M - day 1-5 FP - day 9-12 LP - day 19-21	Not measured	Not measured	Physical working capacity (PWC ₁₇₀): M & LP < FP
Gordon et al., 2018 (33)	10	20.6±1.6 yrs 169.9±6.4 cm 68.7±7.9 kg	Physically active Regular MC		Counting days Salivary E & P	None reported, mentions saliva E & P suggest regular MC	M - day 1-3 FP - day 9-11 LP - day 19-20 Premenstrual (Pm) - day 27-28	Saliva in pg/ml M 2.2±0.1 FP 2.4±1.0 LP 2.9±0.3 Pm 2.6±0.7	Saliva in pg/ml M 66.5±44.9 FP 66.7±33.7 LP 146.4±62.4 Pm 47.4±3.9	VO _{2max} , cardiac output, stroke volume, heart rate: No difference
Hashimoto et al., 2014 (38)	6	23±2.6 yrs 156±2.4 cm 48.7±6.1 kg	4 sedentary 2 active Healthy Regular MC	OC use	Counting days BBT Serum E & P	Serum P limit >16.3 nmol/L during LP	FP LP Days not specified	FP 43.4±244.1 LP 521.6±148.3	FP 0.95±0.03 LP 42.6±22.3	Time trial: No difference
Janse de Jonge et al., 2012 (39)	8 (12-4)	23.7±4.1 yrs 165.8±4.2 cm 67.8±9.8 kg	Recreationally active Healthy Regular MC	OC use or hormonal supplements in last 6 months Medication 4 out of 12 excluded due to low P in LP	Counting days BBT Serum E & P	Serum P limit >16 nmol/L during LP	Early FP - day 3-6 Mid-LP - day 19-25	Temperate FP 123.8±37.6 LP 394.1±65.6 Hot, humid FP 123.4±35.9 LP 376.0±99.4	Temperate FP 1.3±0.3 LP 35.1±10.7 Hot, humid FP 1.3±0.8 LP 36.8±18.1	Prolonged exercise performance in temperate conditions: No difference Prolonged exercise performance in hot, humid conditions: FP > LP (p<0.05)
Julian et al., 2017 (43)	9 (10-1)	18.6±3.8 yrs 161.2±6.6 cm FP 59.1±7.7 kg LP 58.8±7.5 kg	Sub-elite soccer players, competitive soccer for min 5 years Regular MC (24-35 days)	Hormonal contraception Illness Injury 1 excluded due to incorrect timing for LP	Counting days MC diary serum E & P	Mentions serum E & P used to verify timing of test, but no limits set	Early FP - day 5-7 Mid LP - day 21-22	FP 93.4±81.1 LP 403.1±204.1	FP 2.2±0.6 LP 6.5±2.0	Counter movement jump, sprint, endurance performance (Yo-Yo IET): No difference Endurance performance: trend towards FP > LP (p=0.07)
Kumar et al., 2013 (13)	30	21.3±2.3 yrs 160.7±4.5 cm 60.0±6 kg	Healthy Regularly MC	OC use or irregular MC in past year	Counting days	None reported	2 nd day of each phase	Not measured	Not measured	Reaction time: LP > FP

Pallavi et al, 2017 (16)	100	18.4±0.7 yrs 150±0.6cm 50.0±4.9 kg	Untrained to moderately trained Healthy Regular MC Stable dietary habits	OC use Injuries Psychiatric illness Drug use	No method reported	None reported	M FP LP Days not specified	Not measured	Not measured	Handgrip strength and work done: FP > M & LP Fatigue rate: FP < M & LP
Shakhlina, et al., 2016 (25)	13	17-24 yrs	Middle distance runners Regular MC	OC use	BBT Ferning test	Rise in BBT Positive ferning test	M - day 1-5 Post-menstrual - day 6-12 Ovulatory - day 13-15 Post-ovulatory - day 16-24 Premenstrual - day 25-27	Not measured	Not measured	Bicycle ergometer test, 4x400m running, heart rate and lactate concentration: Post-menstrual & post-ovulatory > menstrual, ovulatory & premenstrual
Stefanovsky et al., 2016 (11)	8	18.1±3.4 yrs 165.4±5.1cm 63.9±10.4 kg	Judo athletes Regular MC Non-smokers	Prior OC use Medications	Counting days	None reported	FP - day 6-10 LP - day 20-24	Not measured	Not measured	Wingate test, overall performance in judo fitness test; No difference Number of judo throws in first 15 seconds of test: LP > FP
Tenan et al., 2016 (23)	9	24.7±4.5 yrs	Recreationally active Regular MC	Hormonal contraception in last 6 months Neurologic, endocrine and metabolic disorders, leg injury, surgery or arthritis	Counting days BBT	Clear biphasic response in BBT	Early FP - mid 1 st half FP Late FP - mid 2 nd half FP Ovulatory - 3 days around ovulation Mid-LP - mid 1 st half LP Late LP - mid 2 nd half LP	Not measured	Not measured	Maximal isometric knee extension force: Mid-LP < Late FP, ovulatory & Late LP Time to task failure: No difference

Tsampoukos et al., 2010 (29)	8 (14-6)	20.1±0.3yrs 168±1 cm 64.5±1.7 kg	Highly active Regular MC	OC use in last 4 months Smoker Medication MC> 40 days 6 out of 14 excluded due to LP or LH surge problems	Counting days MC diary Urinary LH Serum E & P	Serum P >9.54 nmol/L in LP LP length of 11-17 days	FP Mid Cycle (prior to ovulation on day of urinary LH surge) LP	FP 170±21 Mid 731±70 LP 508±64	FP 2.2±0.03 Mid 5.1±0.4 LP 29.4±3.5	Peak power output, mean power output and blood lactate of 2 x 30 seconds sprint on treadmill: No difference
Vaiksaar et al., 2011 (40)	15	CCA: 18.8±2.1yrs 174.0±4.2cm 69.0±10.7 kg RCA: 18.0±0.9 yrs 169.8±5.2cm 65.7±6.5 kg	8 competitive rowers (CCA) 7 recreationally trained rowers (RCA) Regular MC (24-35 days)	Injuries Diseases Medications OC use in last 6 months MC > 35 days	Counting days MC diary Serum E & P	Serum P >16 nmol/L in LP	FP - day 8±3 LP - day 20±2	CCA: FP 176.8±51.9 LP 481.4±131 RCA: FP 163.4±98.2 LP 517.7±21.7	CCA: FP 1.9±0.5 LP 38.9±11.0 RCA: FP 1.3±0.7 LP 30.2±5.6	Maximal power output, VO _{2max} , heart rate and blood lactate during incremental test on a rowing ergometer: No difference
Wiecek et al., 2016 (42)	16	21.0±1.1 yrs 167.7±5.7cm 59.8±6.8 kg	Physically active Healthy Non-smokers	Hormonal drugs in last 12 months	Counting days BBT Serum E & P	Rise in BBT of 0.5°C No E & P limits set	FP - day 6-9 LP - 5-8 days after ovulation based on rise in BBT	FP 0 - 160 LP 99.1 - 903	FP 1.02 – 6.36 LP 3.5 – 89.04	Anaerobic performance, starting speed and anaerobic endurance in 20 seconds cycling sprint: No difference

BBT: Basal body temperature, E: Estrogen, FP: Follicular phase, HR: heart rate, LP: Luteal phase, LH: Luteinizing hormone, M: Menstrual phase, MC: Menstrual cycle, Mid: Mid cycle, OC: Oral contraceptives, Pm: Premenstrual phase, P: Progesterone, VO_{2max}: Maximal oxygen consumption