

L'ATHLETE FEMININE

Physiologie, performance et cycle menstruel

11 Novembre 2023 – Colloque de entraineurs FFESSM – INSEP

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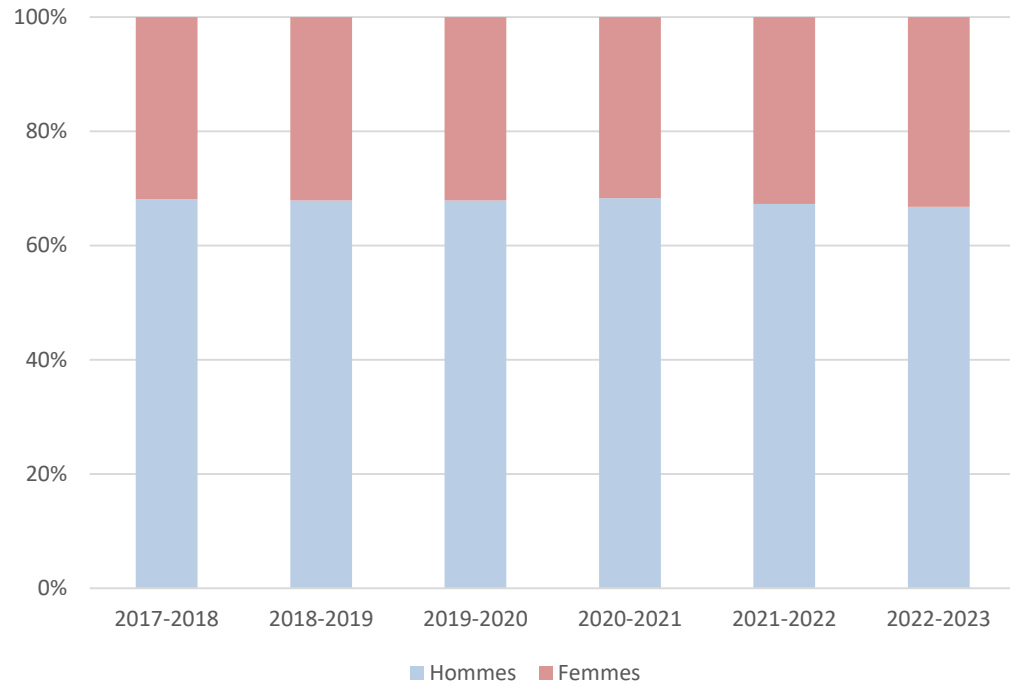
Prise en compte : projet EMPOW'HER



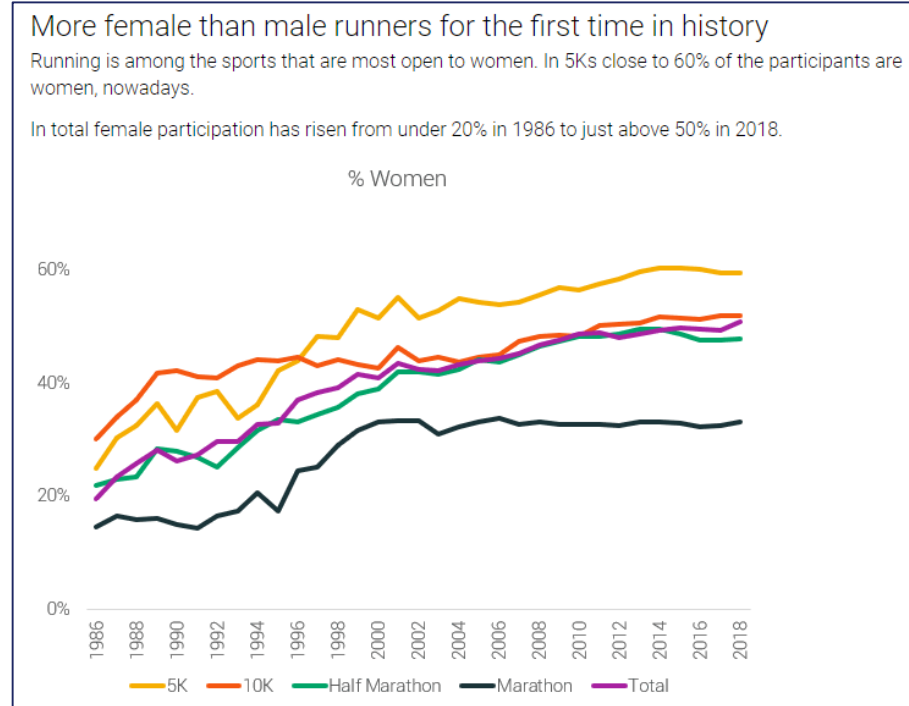
Adolescence, grossesse & postpartum, (péri-)ménopause



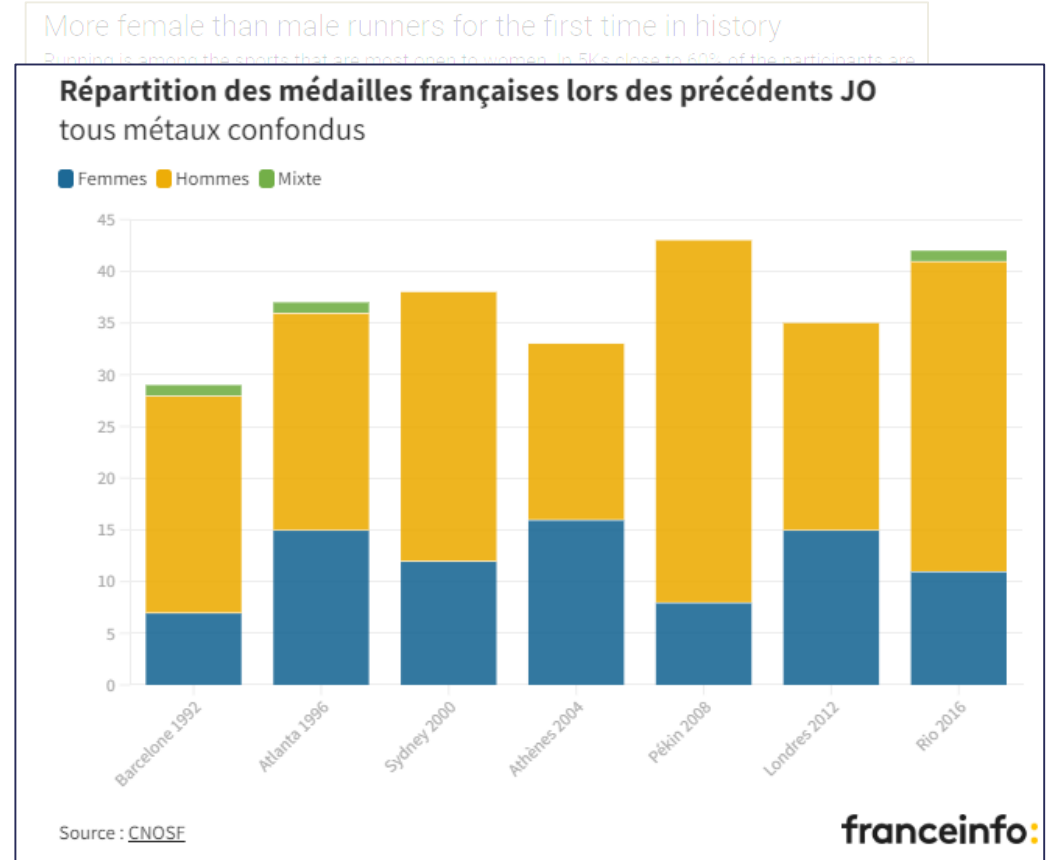
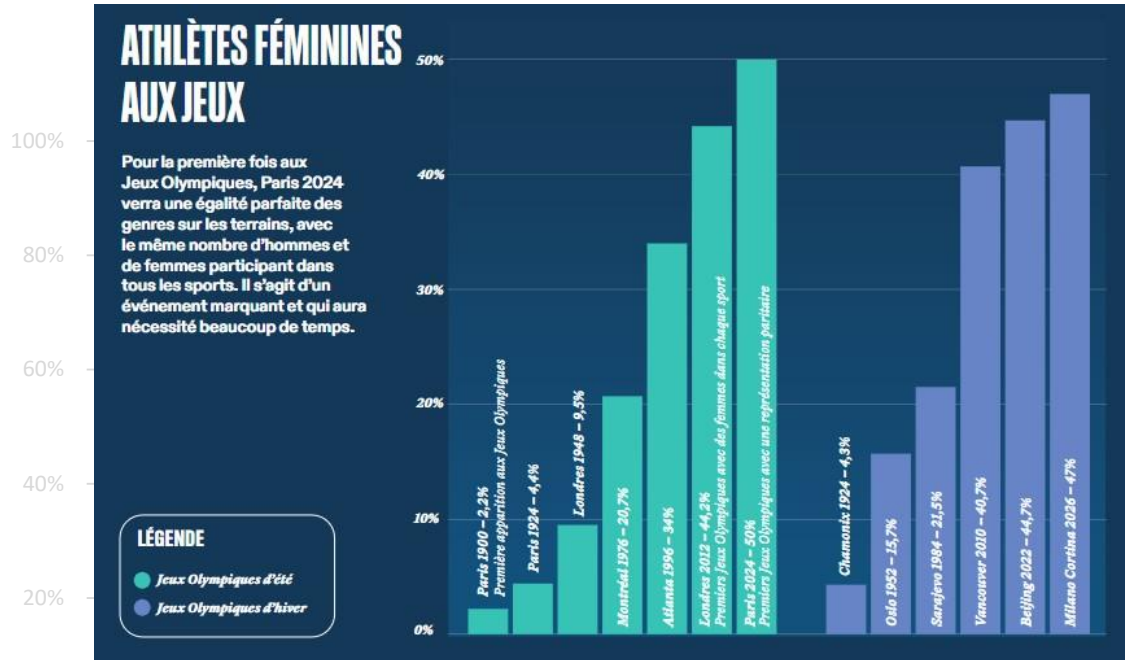
La pratique féminine au sein de la FFESSM et autres disciplines



Pourcentage assez stable ($\approx 30\%$)



La pratique féminine au sein de la FFESSM et autres disciplines



2017-2018 2018

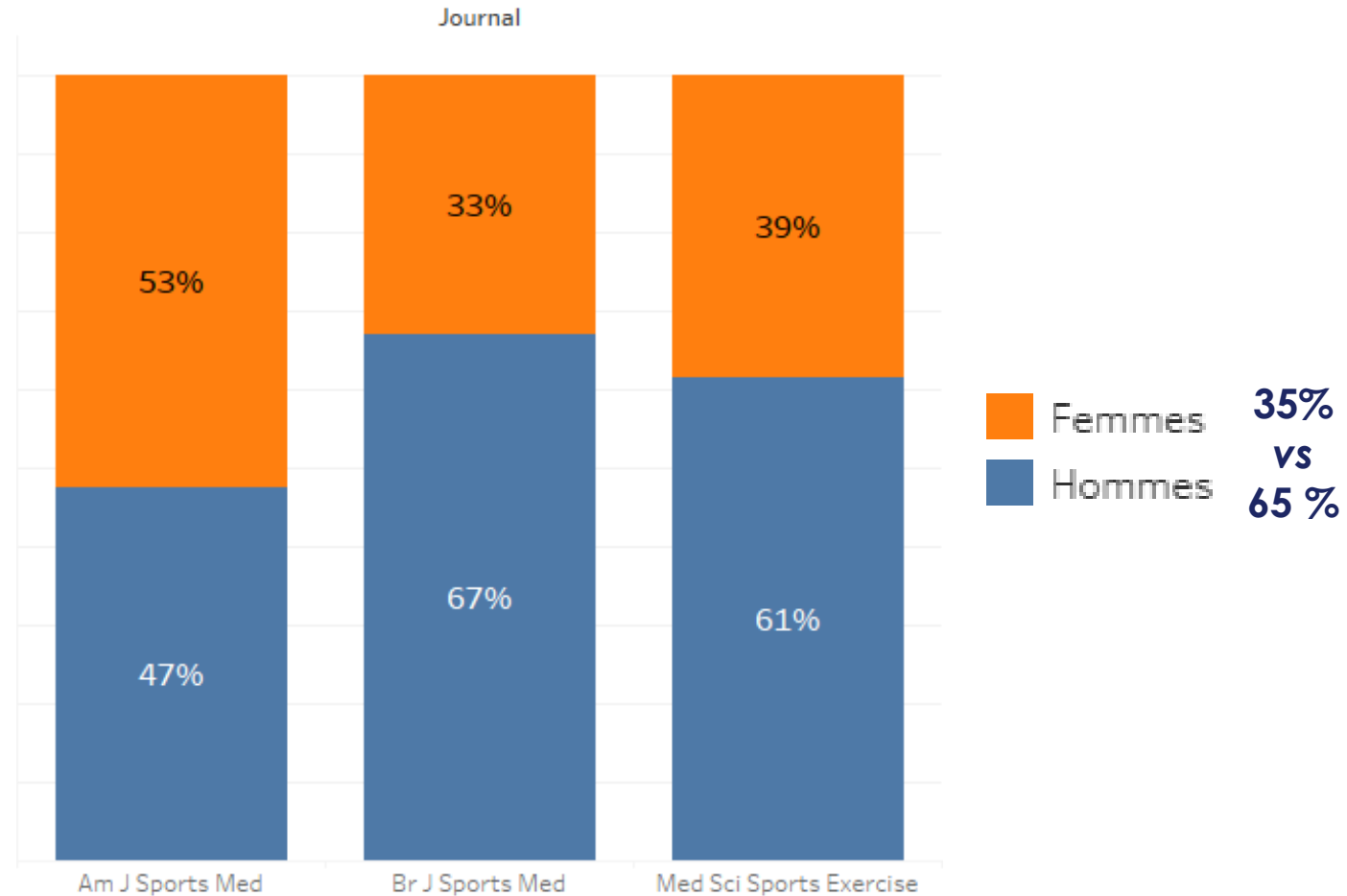


2-2023

Pource

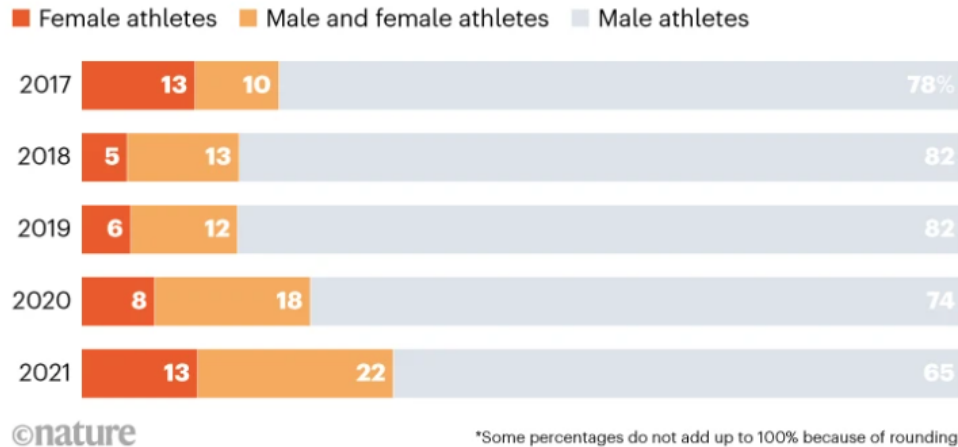
La pratique féminine au sein de la FFESSM et autres disciplines

Le « Sex Data Gap » en sciences du sport



La pratique féminine au sein de la FFESSM et autres disciplines

Le « Sex Data Gap » en sciences du sport



♀ 9%
vs
♂ 71%

Manque de recherches et donc de données, d'informations pour savoir où sont les similitudes ou les différences en termes de réponses à l'exercice / à l'entraînement



La majorité des recommandations de méthodologies d'entraînement, de récupération, de nutrition etc. sont basées sur la physiologie masculine

Spécificités féminines : physiologie & variations hormonales

Des demandes physiologiques variables selon les disciplines



Apnée
Statique
Dynamique
Dynamique sans palme
Poids constant
Jump Blue
Sprint / endurance



Plongée
Sous-marine
Souterraine
Sportive en piscine



Hockey subaquatique
Tir sur cible
Pêche sous-marine



Spécificités féminines : physiologie & variations hormonales

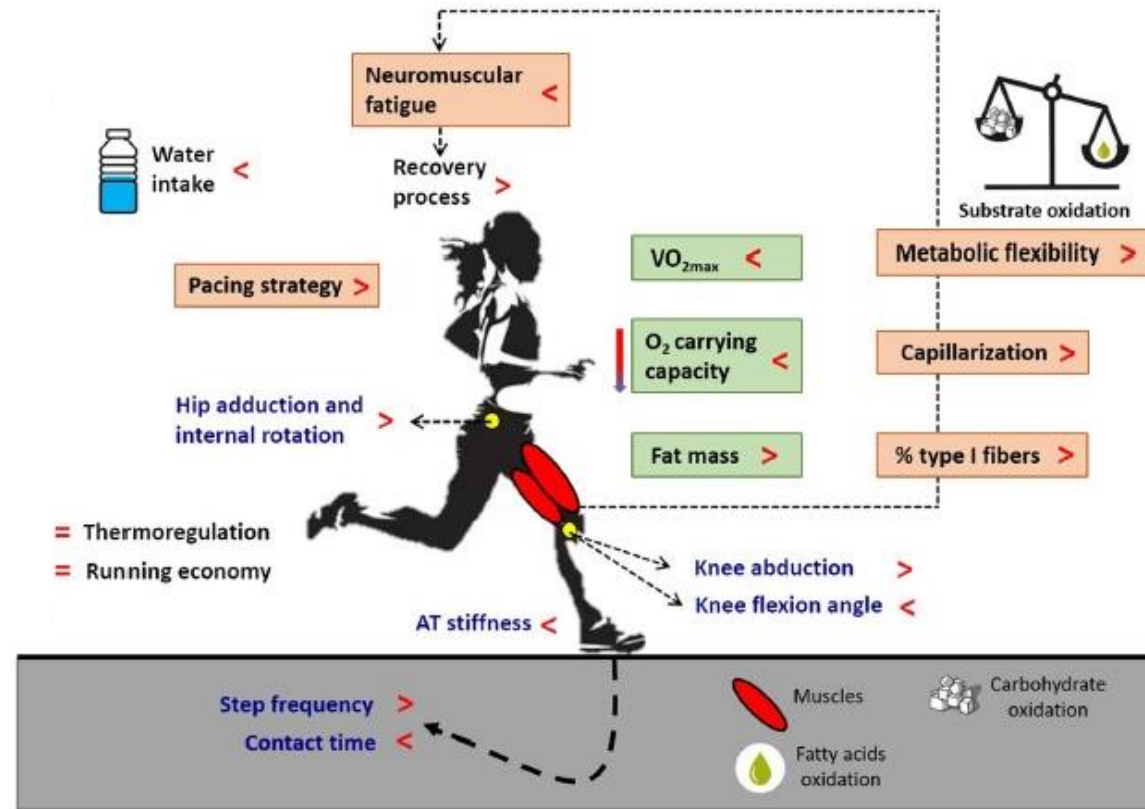
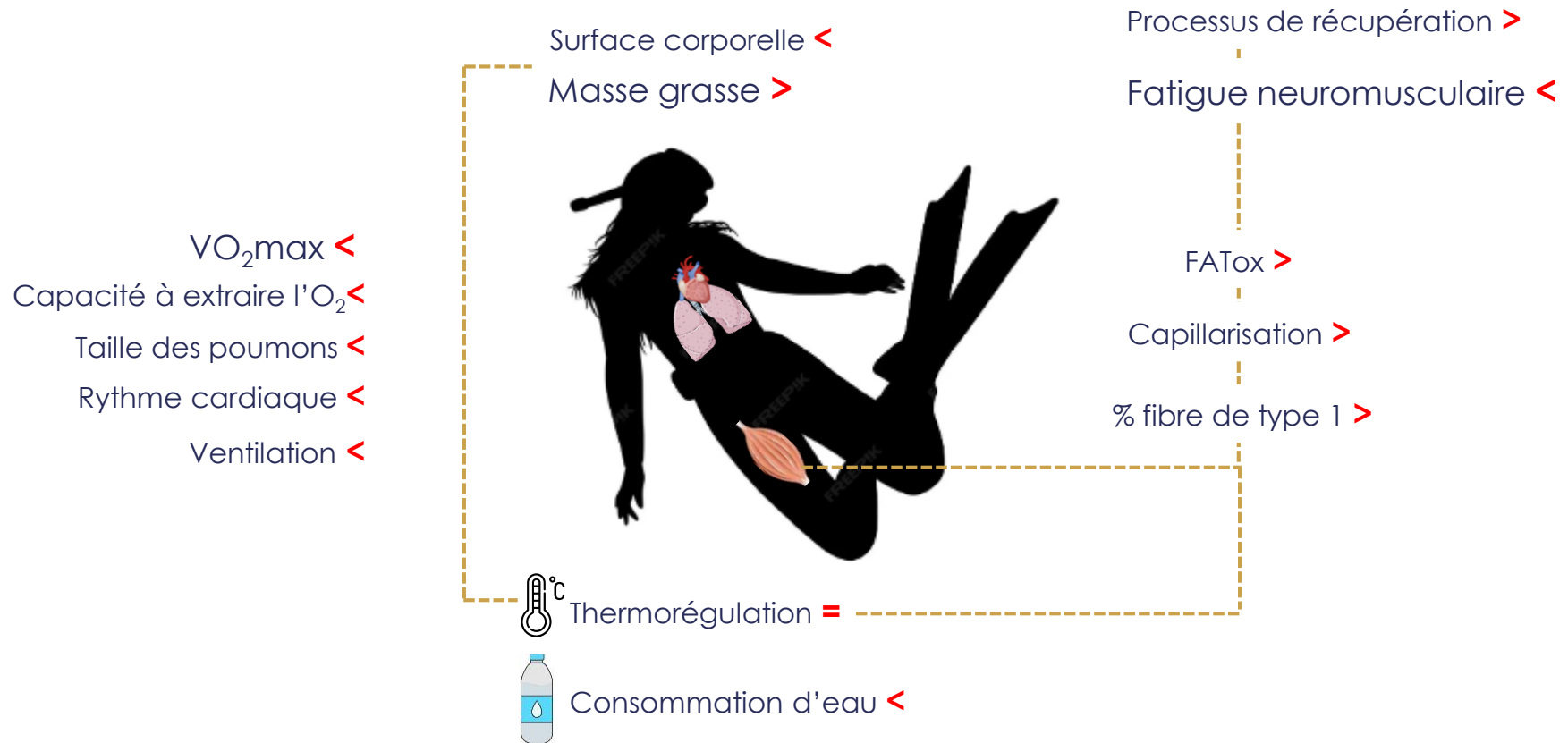


Fig.1 This schematic representation of a female runner is an overview of the main psychological, physiological, neuromuscular and biomechanical sex differences in endurance running. Parameters that could give an advantage to males and to females in endurance run-

ning performance are boxed in green and orange, respectively. >: superior in females, <: inferior in females, =: no sex difference, AT Achilles tendon, O₂ oxygen, VO_{2max} maximal oxygen uptake

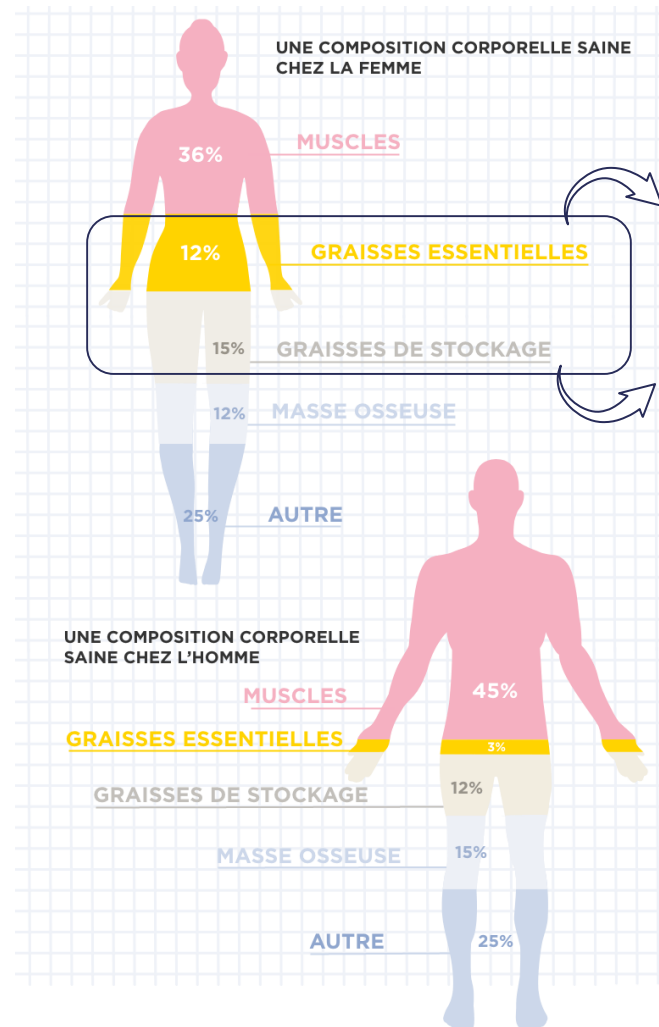
Spécificités féminines : physiologie & variations hormonales



PERFORMANCE ?
RISQUE D'ACCIDENT DE DECOMPRESSION ?

Spécificités féminines : physiologie & variations hormonales

Composition corporelle et métabolisme énergétique



Graisses nécessaires au bon fonctionnement physiologique (ex: synthèse d'hormones)

Au niveau du tissu adipeux sous-cutané, des muscles et de manière ectopique
Chez la femme : stockage « gynoïde »



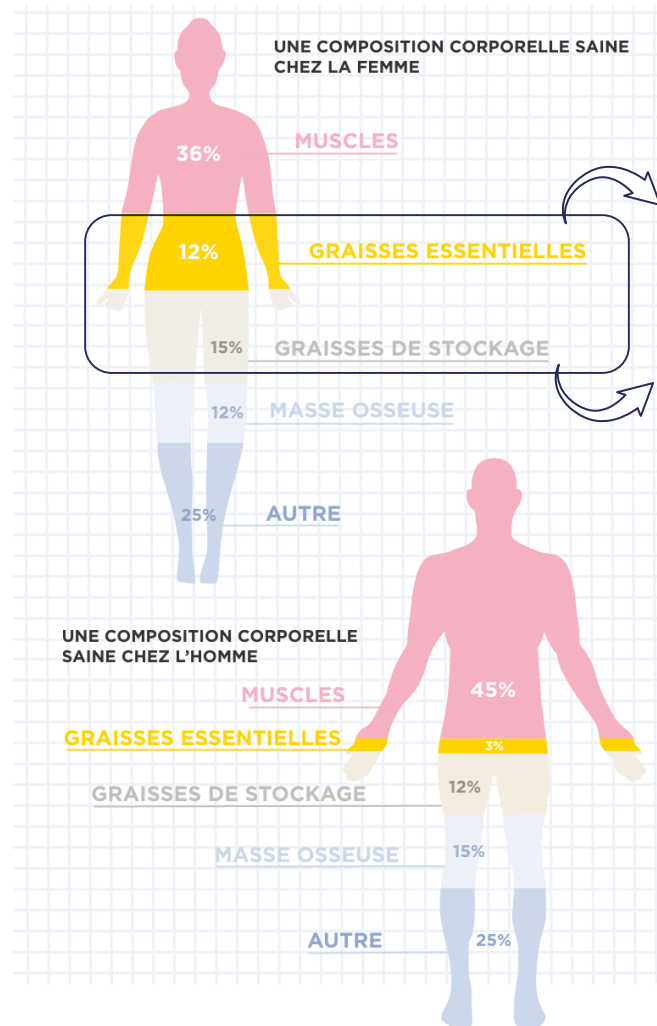
A masse corporelle, taille et capacités physiques égales :

% de masse grasse >

% de masse musculaire <

Spécificités féminines : physiologie & variations hormonales

Composition corporelle et métabolisme énergétique



A masse corporelle, taille et capacités physiques égales :

% de masse grasse >

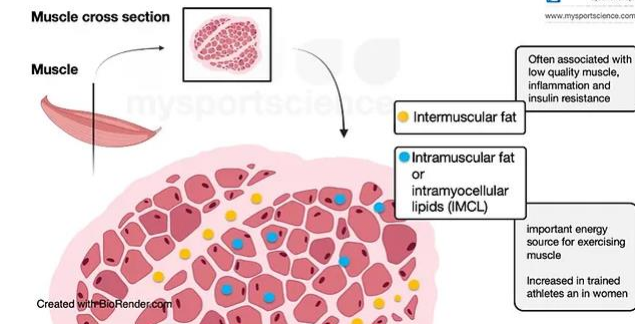
% de masse musculaire <

Graisses nécessaires au bon fonctionnement physiologique (ex: synthèse d'hormones)

Au niveau du tissu adipeux sous-cutané, **des muscles** et de manière ectopique
Chez la femme : stockage « gynoïde »

↓
graisses intramusculaires

Intramuscular fat



Spécificités féminines : physiologie & variations hormonales

Composition corporelle et métabolisme énergétique

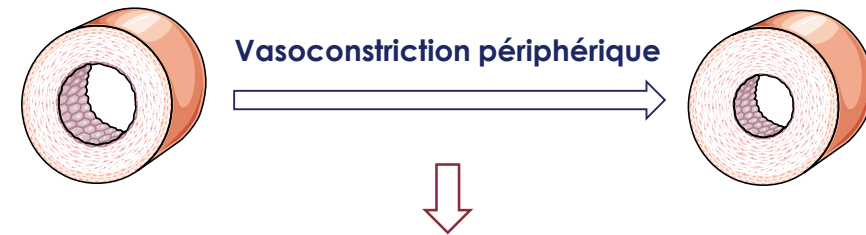
Nombre de gouttelettes lipidiques intra musculaires >
→ disponibilité d'acides gras dans le plasma >



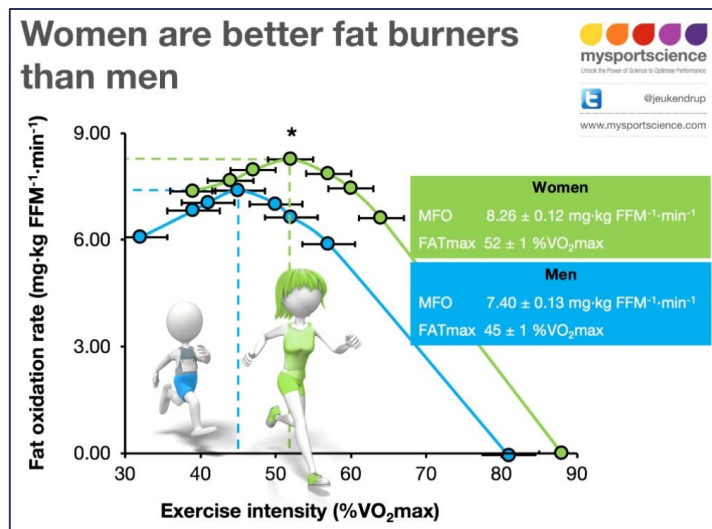
+

% de fibres de type I (fibres dites « oxydatives ») >
capacité des enzymes oxydatives >
densité capillaire >

Un avantage ? pas sûr...



Nécessité d'avoir un métabolisme anaérobie
développé et efficace / efficient

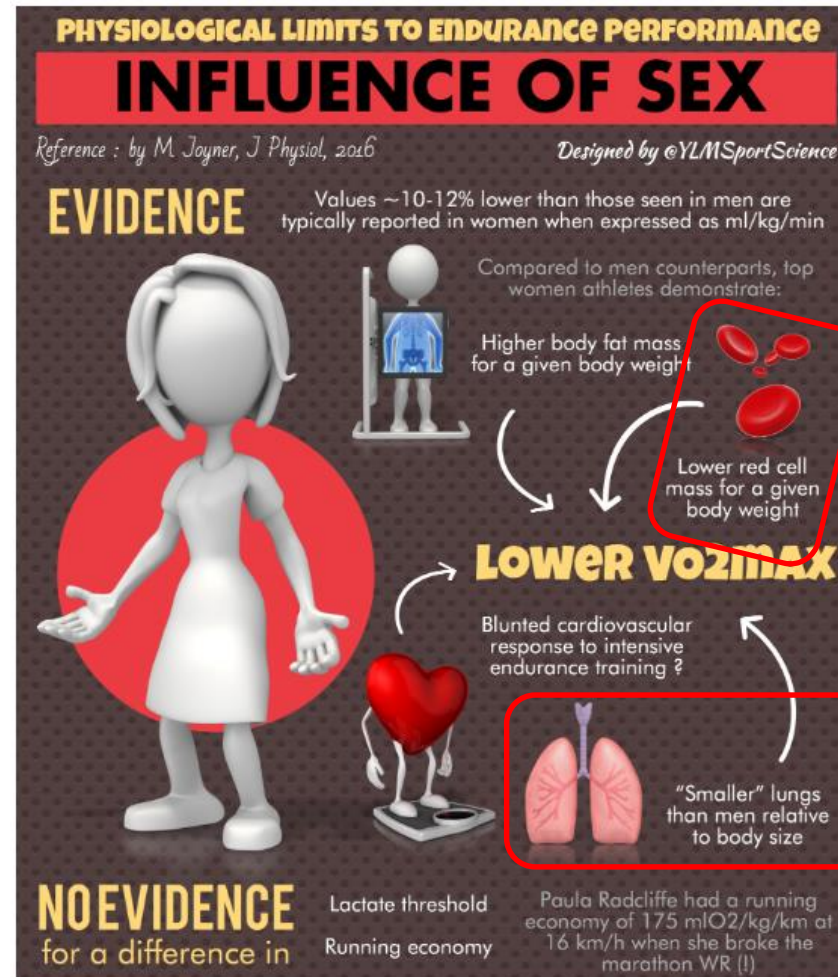


Spécificités féminines : physiologie & variations hormonales

Capacités cardio-vasculaires et respiratoires

$VO_2\max <$

$VO_2\max$ = la consommation maximale d' O_2
= Quantité maximale d' O_2 qu'un organisme peut utiliser
par unité de temps.
L/min ou mL/min/kg



→ Taux d'Hémoglobine (Hb) <

Spécificités féminines : physiologie & variations hormonales

Thermorégulation et hydratation

 **La thermorégulation** (eau froide) dépend de plusieurs facteurs :

- La surface corporelle <
- Le % de masse grasse >
- Le « ratio » métabolique <
- L'oxydation des substrats (FATox) >

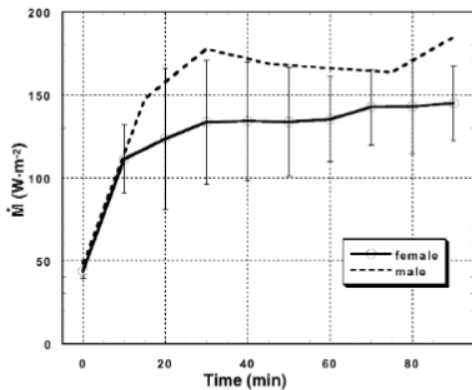
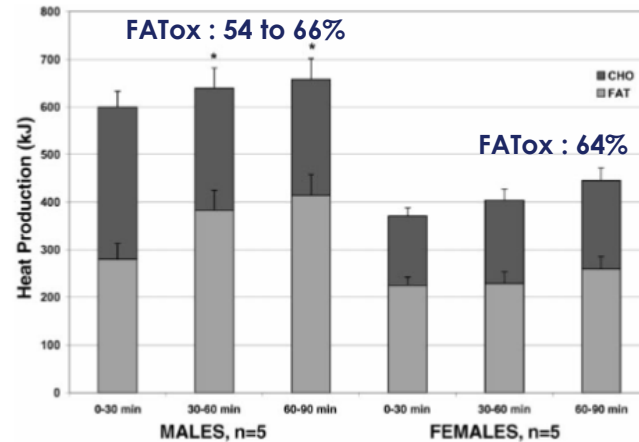


Fig. 2. Metabolic rate (M) of women during neck-level immersion in 18°C water. Values are means \pm SD; $n = 11$, except after 60 min, when $n = 9$. Mean values for men are from Ref. 16; $n = 14, 9, 8$, and 7 for immersion times up to 30, 45, 60, and 90 min, respectively.



Thermorégulation =

Spécificités féminines : physiologie & variations hormonales

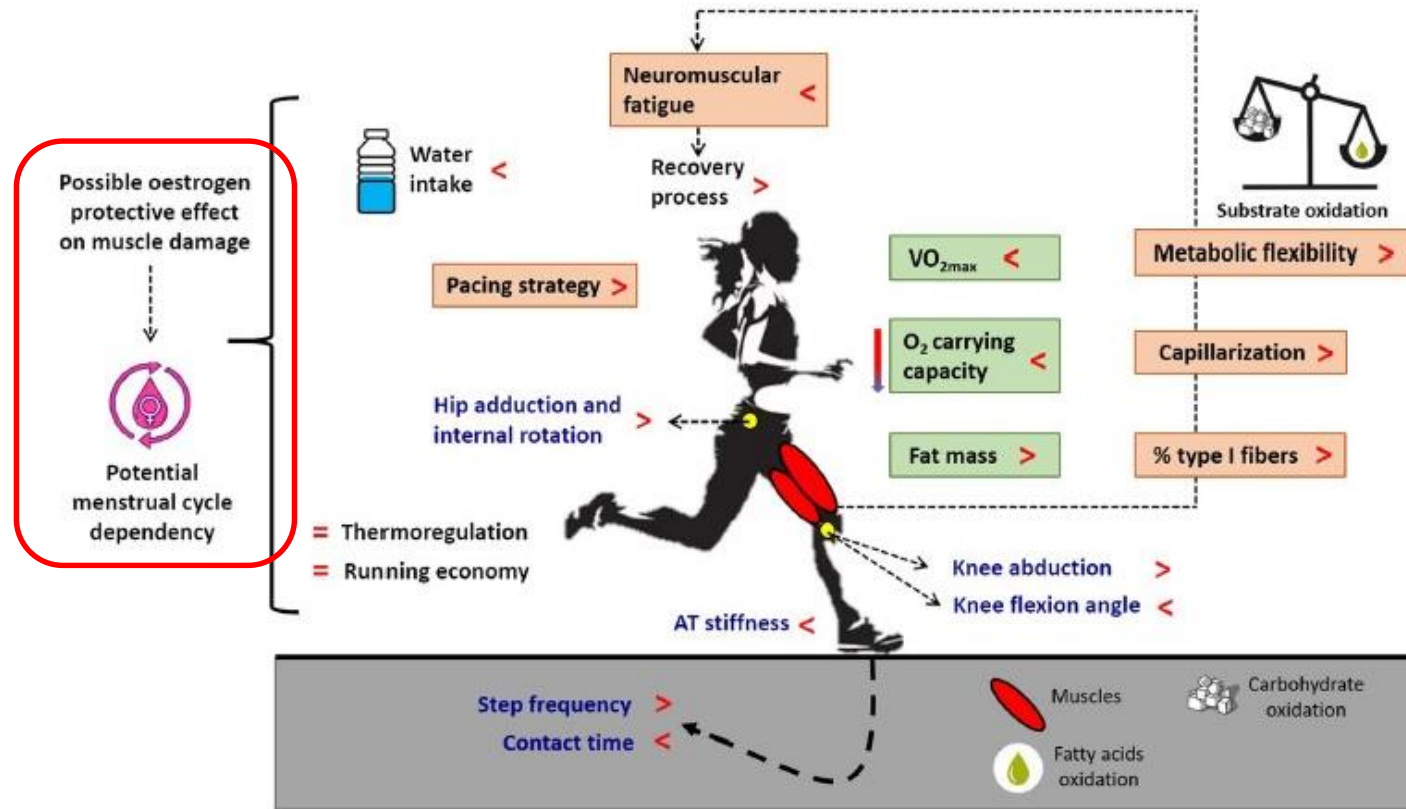


Fig. 1 This schematic representation of a female runner is an overview of the main psychological, physiological, neuromuscular and biomechanical sex differences in endurance running. Parameters that could give an advantage to males and to females in endurance run-

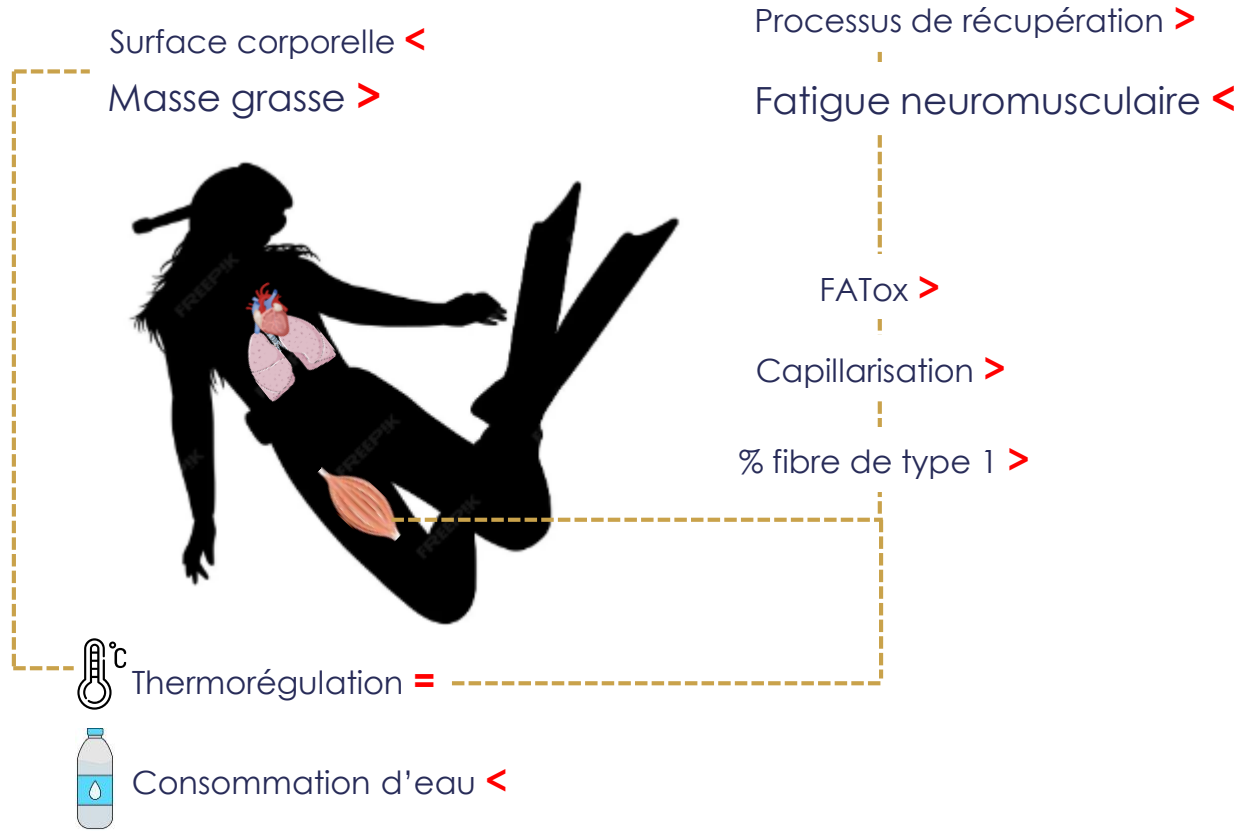
ning performance are boxed in green and orange, respectively. >: superior in females, <: inferior in females, =: no sex difference, AT Achilles tendon, O₂ oxygen, VO_{2max} maximal oxygen uptake

Influence des estrogènes et de la progestérone



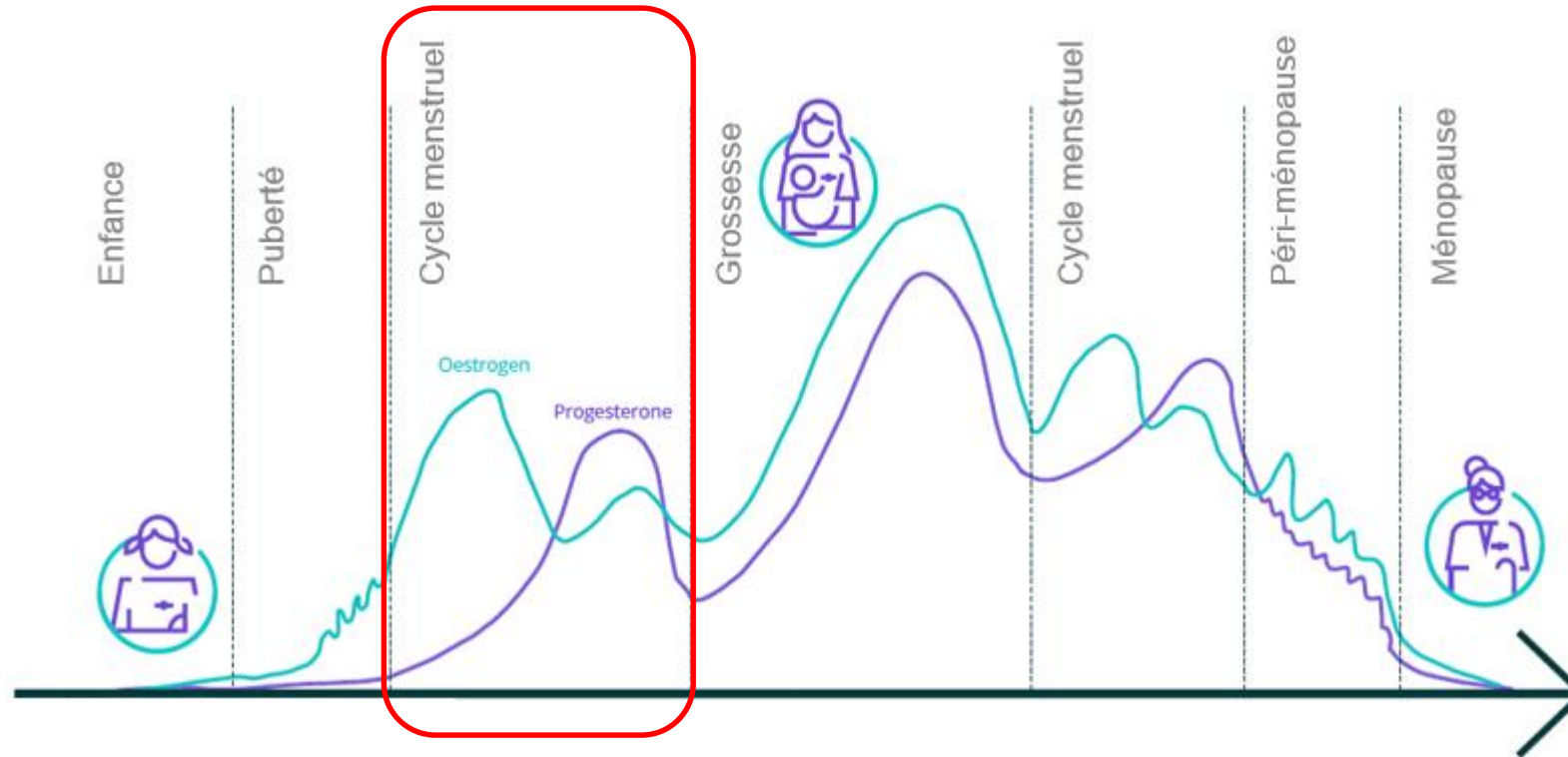
Potentiel impact du cycle menstruel

- VO₂max <
- Capacité à extraire l'O₂ <
- Taille des poumons <
- Rythme cardiaque <
- Ventilation <



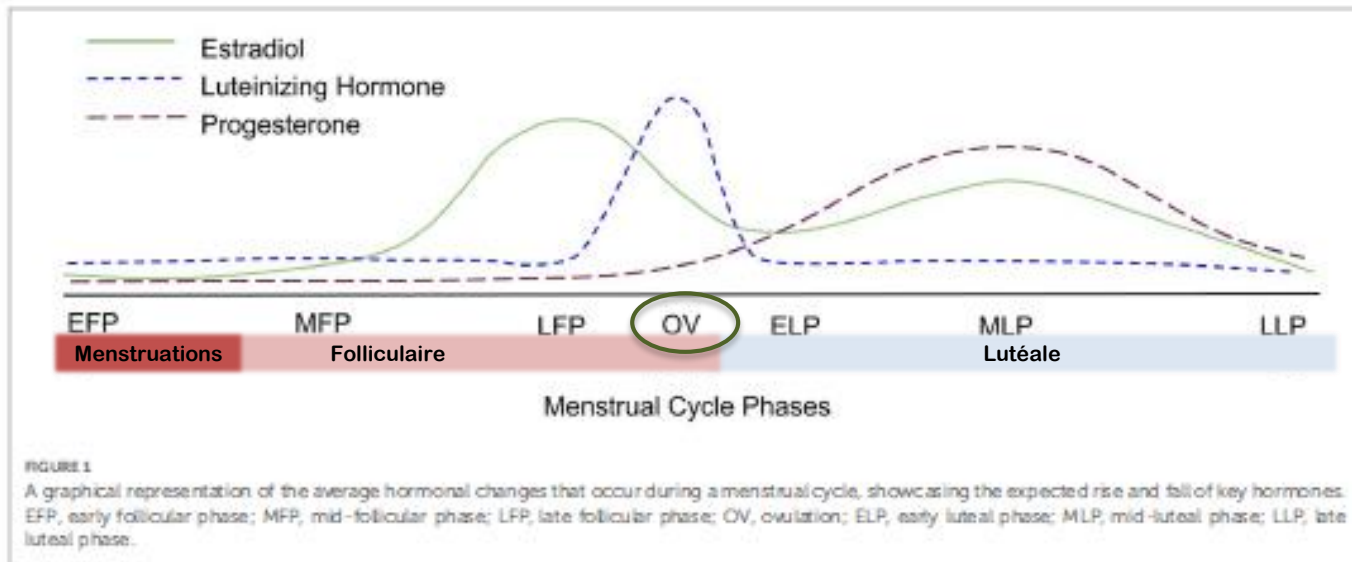
PERFORMANCE ?
RISQUE D'ACCIDENT DE DECOMPRESSION ?

Spécificités féminines : physiologie & variations hormonales

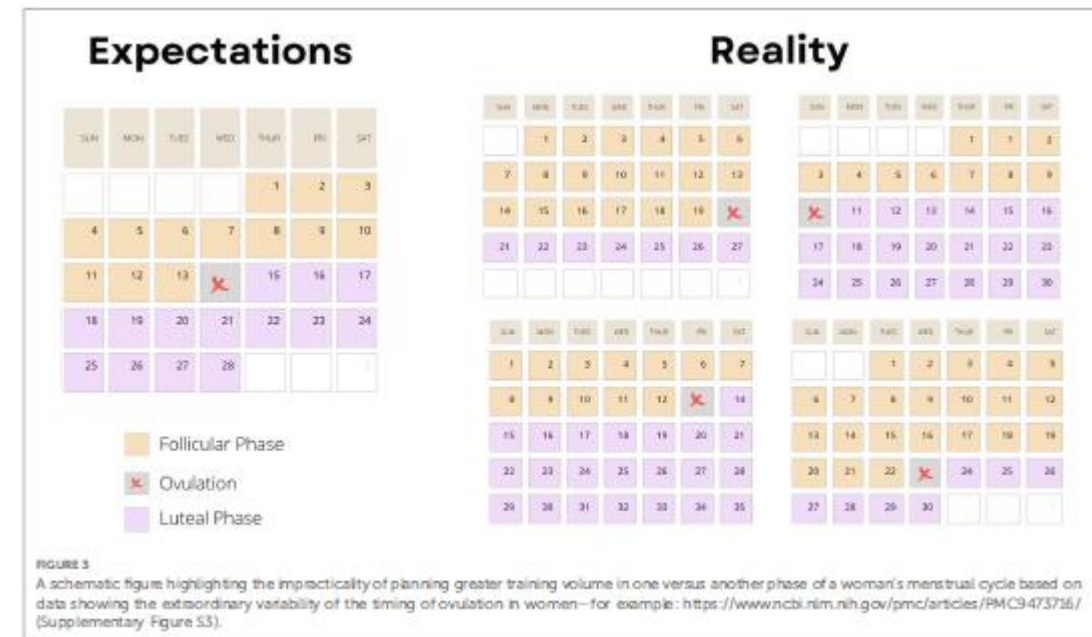


Spécificités féminines : physiologie & variations hormonales

Le cycle menstruel

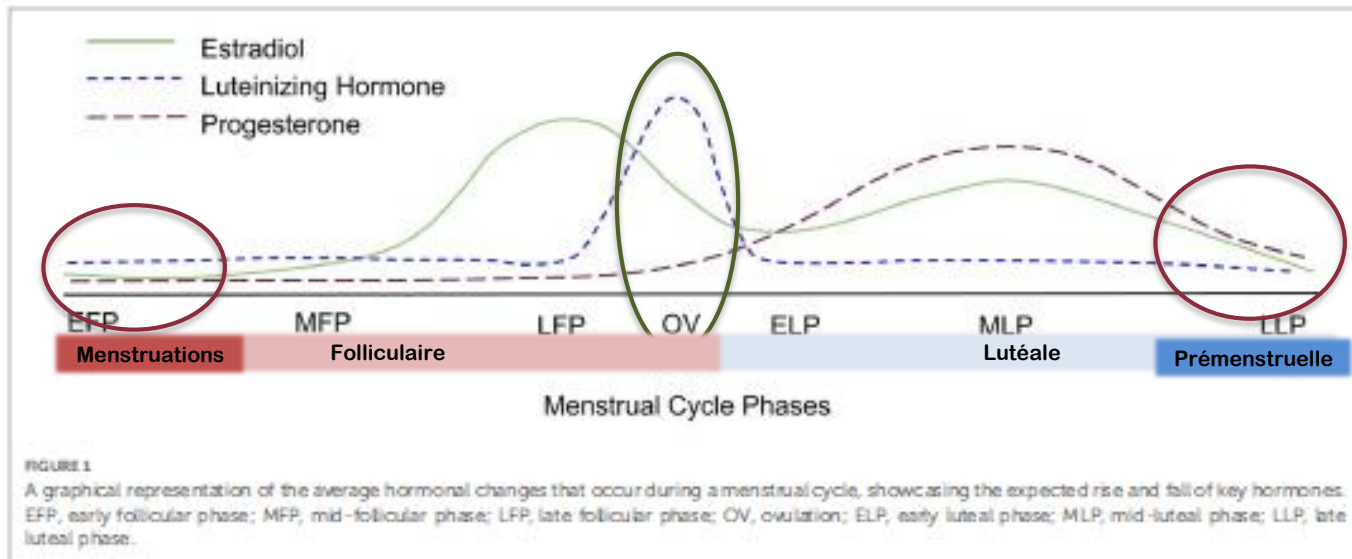


- ✓ 21 – 35 jours
- OU variation des 3 derniers cycles < 7 jours
- +
- ✓ Durée des règles < 8 jours
- +
- ✓ Perte de sang entre 5 et 80mL



Spécificités féminines : physiologie & variations hormonales

Cycle menstruel et symptômes



Les symptômes menstruels physiques ou psychologiques

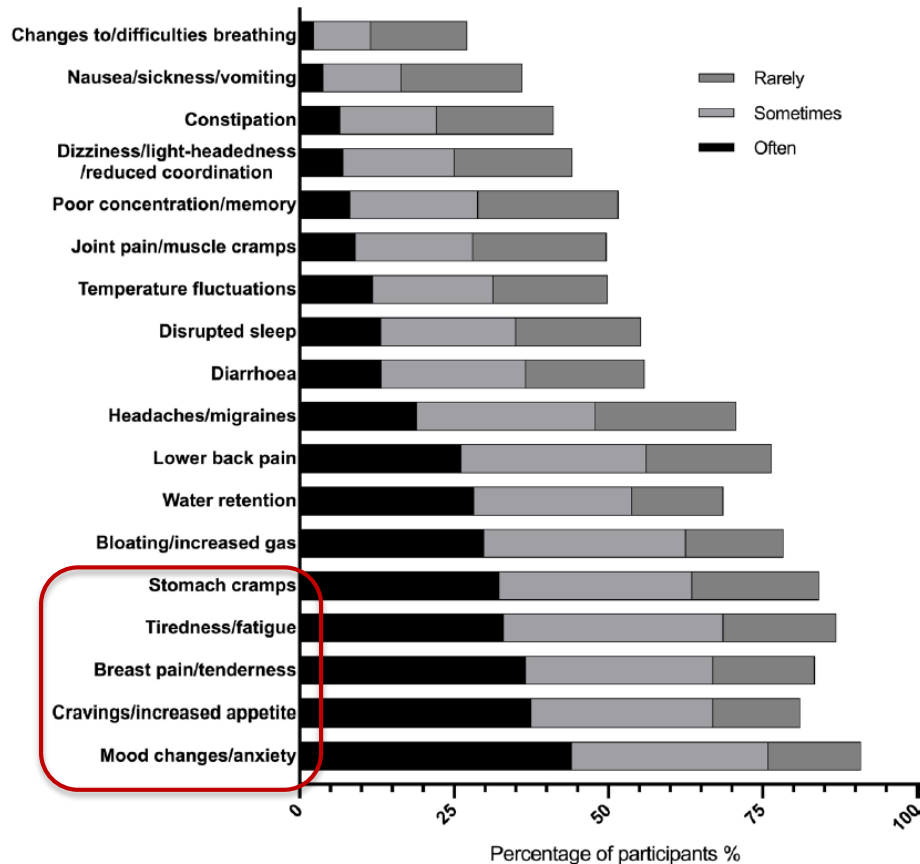
Ils peuvent être à tout moment du cycle
mais certaines phases sont plus propices à leurs apparitions

- | | | | | | | |
|---|---|---|--|--|---|---|
| 
Crampes | 
Mal de dos | 
Maux de tête | 
Nausée | 
Acné | 
Fatigue | 
Troubles du sommeil |
| 
Sensibilité mammaire | 
Constipation | 
Diarrhée | 
Fringales | 
Sautes d'humeur | 
Douleurs musculaires | 
Saignements importants |

Source : Garmin® app

Spécificités féminines : physiologie & variations hormonales

Cycle menstruel et symptômes



Symptômes les plus fréquents et leur occurrence chez presque 7000 femmes actives de différents pays utilisant l'application Strava.

Calcul d'un « Menstrual Symptoms Index »

➤ MS index = ➤ probabilité :

- d'absence ou changement d'entraînement,
- de manquer un événement sportif/une compétition,
- d'absentéisme au travail / à l'université,
- d'utilisation d'analgésiques

Impact sur la vie personnelle, sportive et professionnelle

Figure 2 Stacked bar chart of the frequency of the different types of symptoms experienced by exercising women (N=6812) and the frequency of the occurrence of symptoms.

Spécificités féminines : physiologie & variations hormonales

Cycle menstruel et symptômes



STUDY CHARACTERISTICS

60
Observational Studies
1981 - 2022

6380
Competitive Female Athletes
Not using hormonal contraceptives

63%
Trained & Highly Trained
Tiers 2 and 3

Menstrual cycle-related symptom	<i>n</i>	Mean prevalence (range) (%)
Affective		
Insomnia or hypersomnia	2	53.3 (46.3– 60.3)
Anger or irritability	4	49.2 (0.5–71.6)
Anxiety or tension	3	45.9 (0.5–75.0)
Overeating or food cravings	3	40.3 (0.9–70.4)
Decreased interest in work, home or social	2	40.0 (29.9–50.0)
Fatigue or lack of energy	4	39.5 (4.1–72.7)
Difficulties in concentrating or coordination	3	39.4 (2.3–60.1)
Feeling overwhelmed	2	34.0 (25.9–42.0)
Depressed mood or mood swings	4	25.3 (4.0–61.4)
Physical		
Abdominal cramps	2	58.8 (47.5–70.0)
Physical symptoms/limb oedema	4	32.9 (1.8–78.4)
Abdominal congestion/swelling/bloating	3	17.5 (2.0–45.1)
Back pain	2	16.1 (15.0–17.1)
Breast swelling/tenderness	3	11.4 (0.9–31.4)
Headache	1	9.7
Vomiting/feeling sick	2	4.3 (4.0–4.6)
Acne	1	0.5

n number of studies

Table 6 Prevalence of menstrual cycle-related symptoms occurring during the premenstrual and menstruation phases in athletes

Spécificités féminines : physiologie & variations hormonales

Cycle menstruel et troubles du cycle



Saignements très abondants

La dysménorrhée (règles très douloureuses)

Le syndrome prémenstruel

Le trouble dysphorique prémenstruel

La déficience de la phase lutéale

L'anovulation

L'oligoménorrhée (cycles entre 35 et 90 jours)

L'aménorrhée secondaire (absence de règles > 3 mois)

L'aménorrhée primaire (absence de règles avant 16 ans)

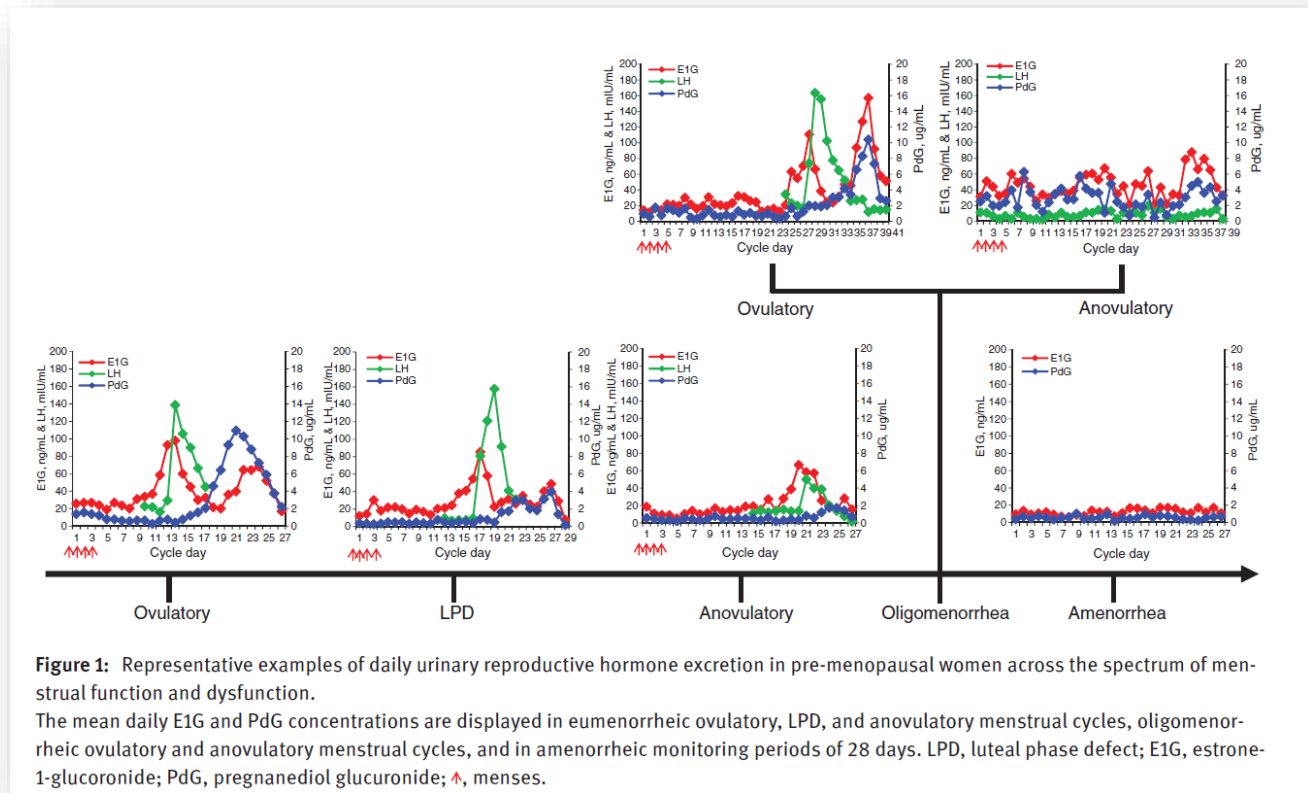


Figure 1: Representative examples of daily urinary reproductive hormone excretion in pre-menopausal women across the spectrum of menstrual function and dysfunction. The mean daily E1G and PdG concentrations are displayed in eumenorrheic ovulatory, LPD, and anovulatory menstrual cycles, oligomenorrheic ovulatory and anovulatory menstrual cycles, and in amenorrheic monitoring periods of 28 days. LPD, luteal phase defect; E1G, estrone-1-glucuronide; PdG, pregnanediol glucuronide; ♀, menses.

Spécificités féminines : physiologie & variations hormonales

Cycle menstruel et troubles du cycle



Table 5 Prevalence of premenstrual syndrome and premenstrual dysphoric disorder symptoms in athletes

PMS/PMDD symptom	<i>n</i>	Mean prevalence (range) (%)
Affective		
Overeating or food cravings	3	69.3 (63.9–72.4)
Anger or irritability	5	68.1 (44.65–80.6)
Anxiety or tension	5	60.7 (18.7–79.9)
Difficulty concentrating	3	58.6 (56.0–60.3)
Depressed mood or mood swings	5	54.9 (40.0–77.4)
Fatigue or lack of energy	4	54.7 (7.6–72)
Insomnia or hypersomnia	3	51.7 (43.9–56.5)
Tearful	3	47.2 (42.2–51)
Decreased interest in work, home or social	4	33.6 (5.3–48)
Feeling overwhelmed	3	31.8 (29.7–34)
Embarrassment or confusion	1	25.3
Physical		
Abdominal congestion/swelling/bloating	1	72.0
Breast swelling/tenderness	2	65.3 (61.3–69.3)
Cramps or back pain	2	61.4 (55.1–67.7)
Physical symptoms/limb oedema	4	51.6 (6.7–75.5)
Headache	2	17.4 (0.0–34.7)
Acne	1	12.7
Diarrhoea	1	2.5

PMDD premenstrual dysphoric disorder, PMS premenstrual syndrome, *n* number of studies

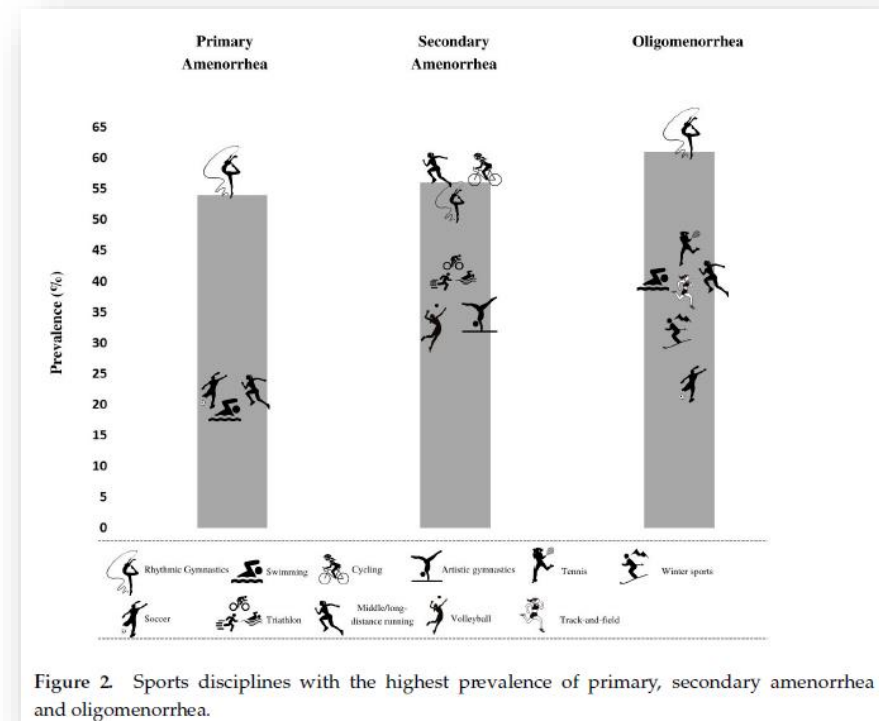


Figure 2 Sports disciplines with the highest prevalence of primary, secondary amenorrhea and oligomenorrhea.

Spécificités féminines : physiologie & variations hormonales

Cycle menstruel et troubles du cycle



Saignements très abondants

La dysménorrhée (règles très douloureuses)

Le syndrome prémenstruel

Le trouble dysphorique prémenstruel

La déficience de la phase lutéale

L'anovulation

L'oligoménorrhée (cycles entre 35 et 90 jours)

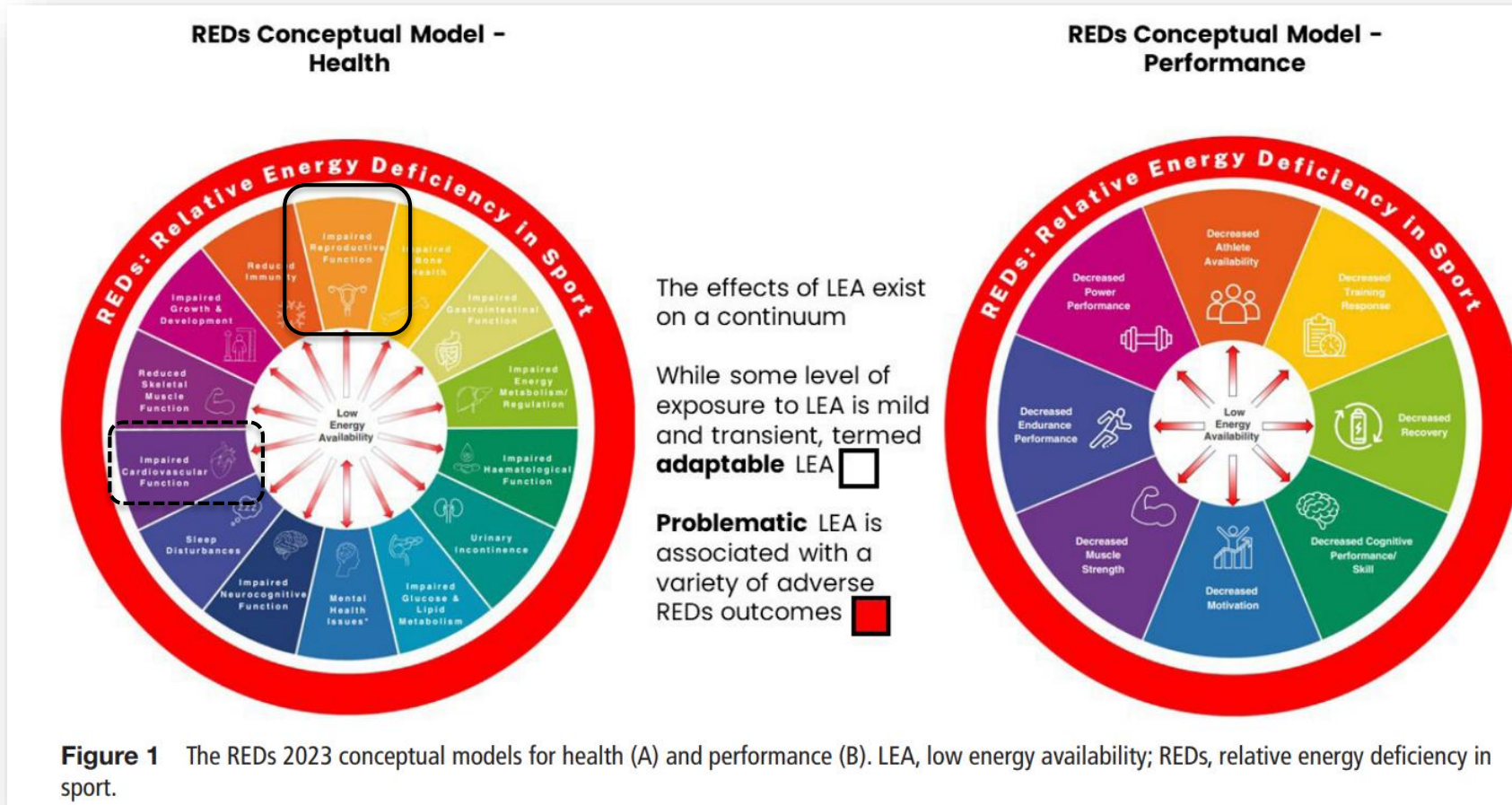
L'aménorrhée secondaire (absence de règles > 3 mois)

L'aménorrhée primaire (absence de règles avant 16 ans)



Spécificités féminines : physiologie & variations hormonales

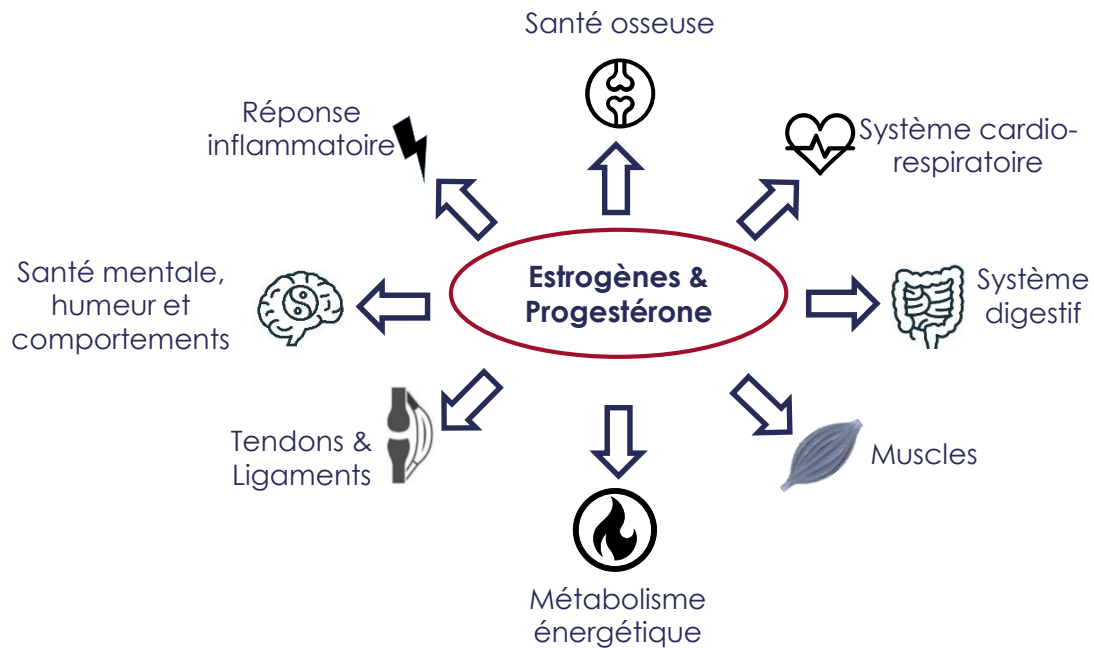
Cycle menstruel et troubles du cycle



Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E_2 et P) vont impacter de nombreux systèmes **psychologiques, biomécaniques, physiologiques**



Composition corporelle

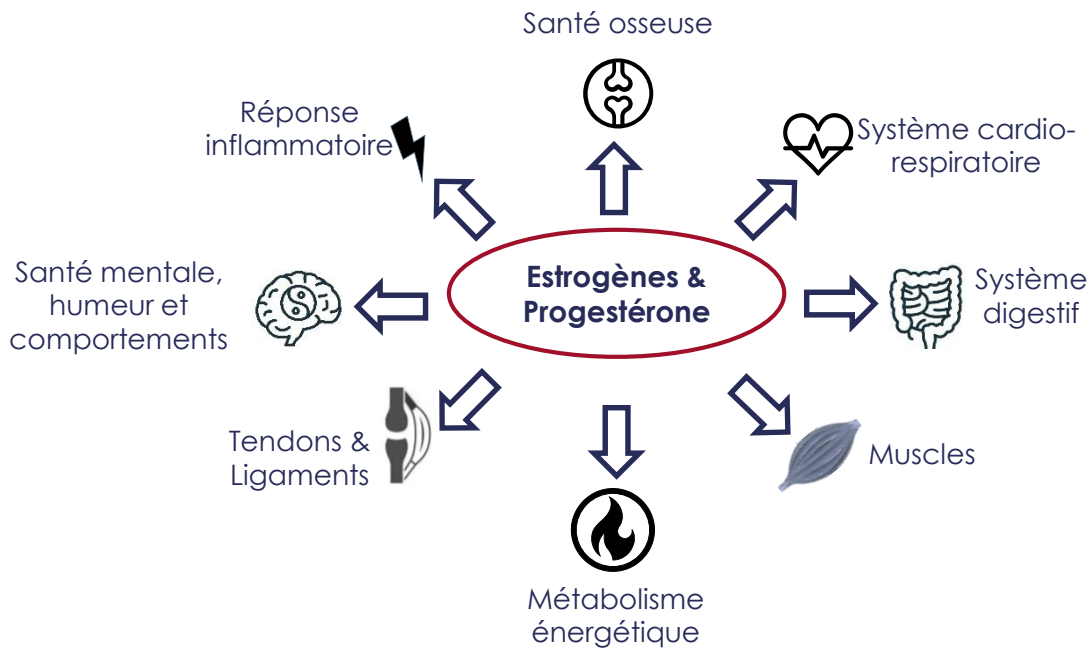


Stockage et localisation des graisses

Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E_2 et P) vont impacter de nombreux systèmes **psychologiques, biomécaniques, physiologiques**



Thermorégulation

Impact des E_2 , de la P4, de la testostérone, des hormones T3-T4 et de l'anémie
Au repos et à l'exercice

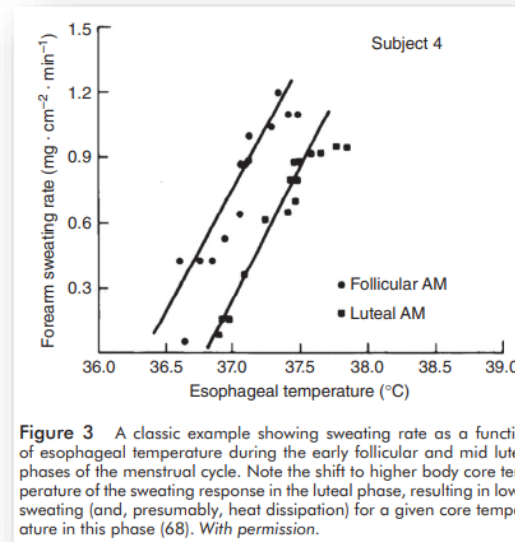


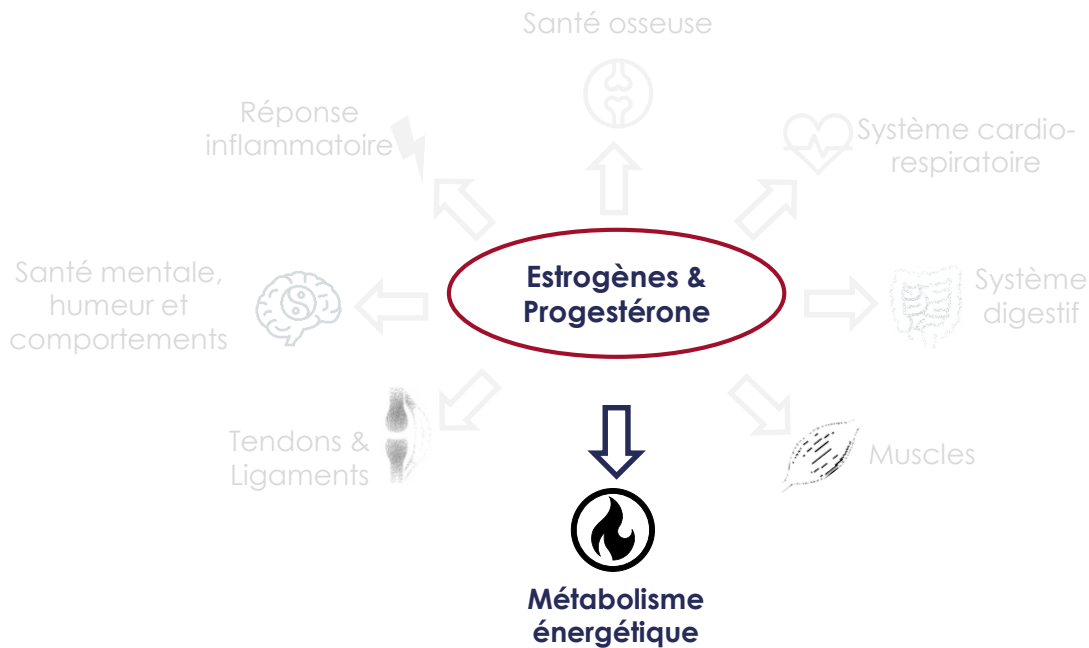
Figure 3 A classic example showing sweating rate as a function of esophageal temperature during the early follicular and mid luteal phases of the menstrual cycle. Note the shift to higher body core temperature of the sweating response in the luteal phase, resulting in lower sweating (and, presumably, heat dissipation) for a given core temperature in this phase (68). With permission.

« thermoregulatory set point » **PF < PL**

Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E₂ et P) vont impacter de nombreux systèmes **psychologiques, biomécaniques, physiologiques**



Métabolisme énergétique

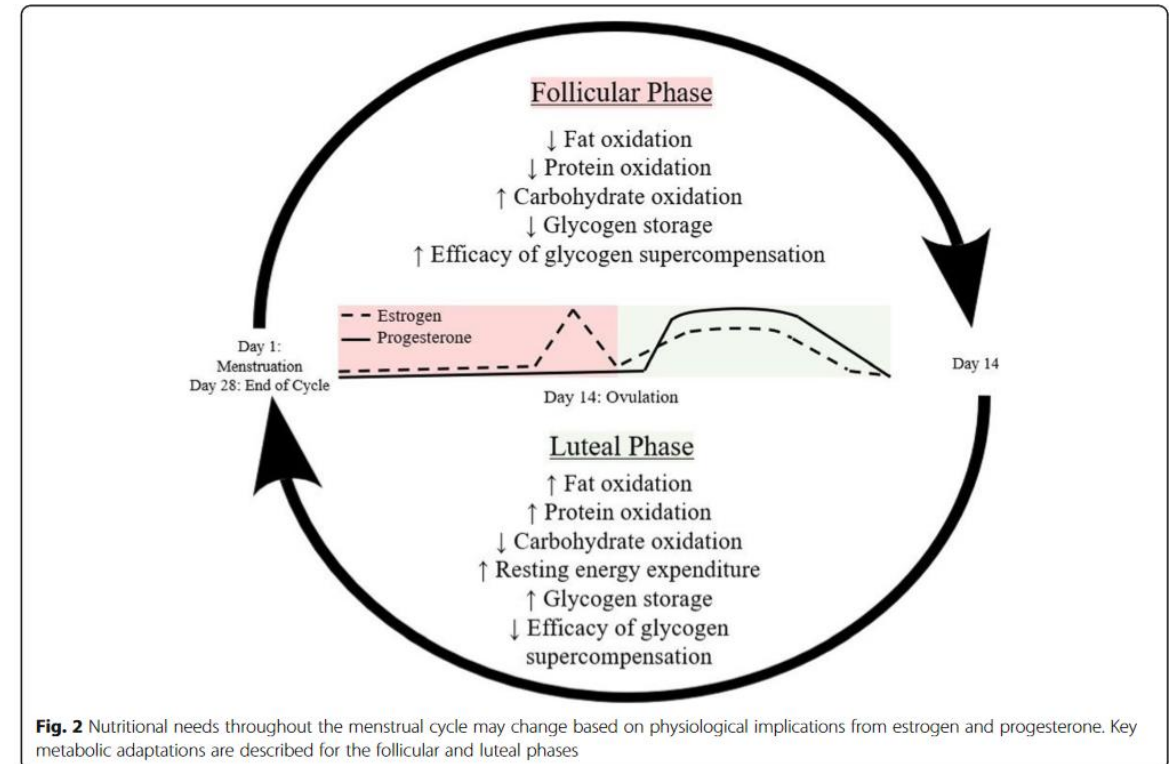


Fig. 2 Nutritional needs throughout the menstrual cycle may change based on physiological implications from estrogen and progesterone. Key metabolic adaptations are described for the follicular and luteal phases

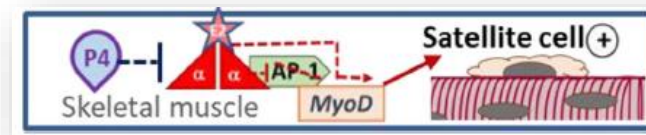
Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E₂ et P) vont impacter de nombreux systèmes **psychologiques, biomécaniques, physiologiques**



Capacités et récupération musculaires



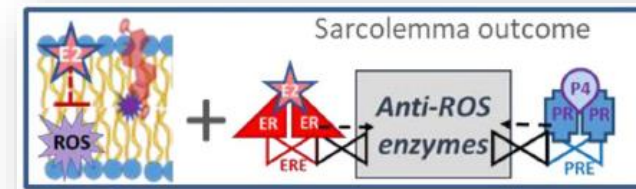
Prolifération et activation
des cellules satellites

PF > PL



Développement des propriétés
contractiles des muscles

PF > PL

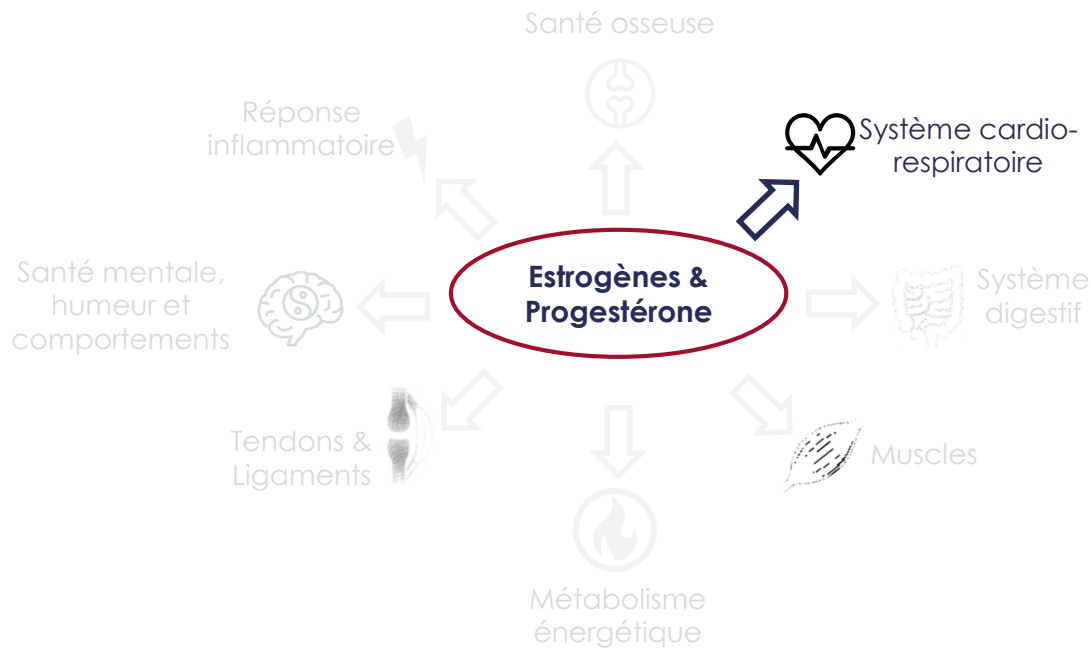


Domages musculaires →
⇒ Processus de récupération ↗
fin PF / mi PL > début PF

Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E_2 et P) vont impacter de nombreux systèmes
psychologiques, biomécaniques, physiologiques



Systeme cardio-respiratoire

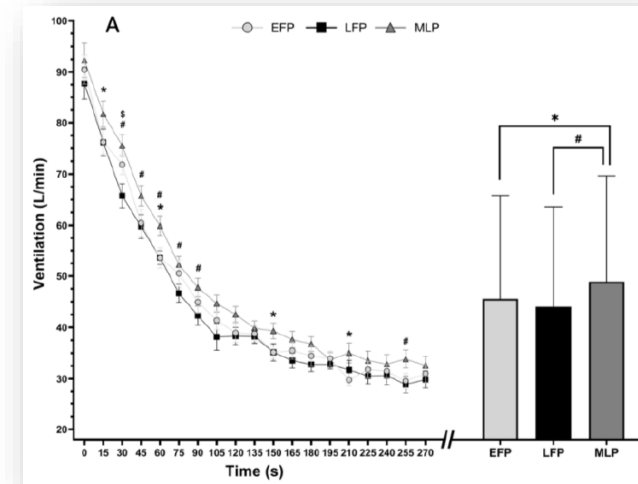


Table 3 Cardiorespiratory and metabolic data for HIT

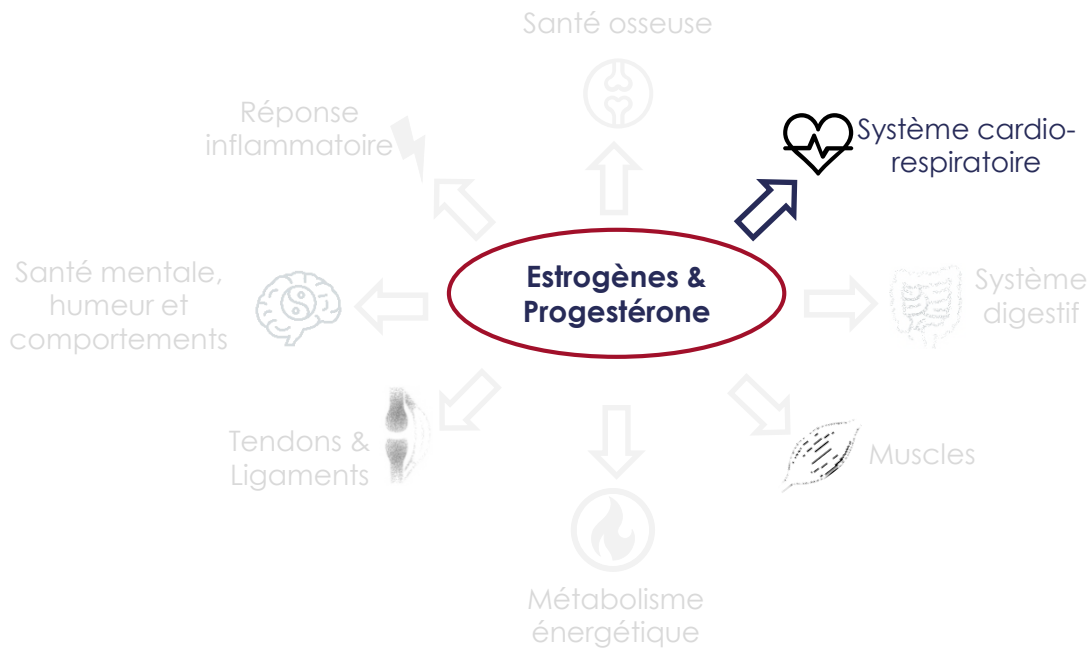
	MC, mean (SD)		OC, mean (SD)		Differences	
	Follicular (low)	Luteal (high)	Sugar (low)	Active (high)	MC phase (P, ES)	OC phase (P, ES)
HR (bpm)	159 (9)	163 (7)	164 (11)	166 (12)	0.17, -0.51	0.88, -0.026
RPE	15 (2)	16 (2)	15 (2)	16 (2)	0.13, -0.59	0.47, -0.27
RER (IU)	0.99 (0.05)	1.00 (0.04)	0.96 (0.02)	0.97 (0.03)	0.13, -0.45	0.18, -0.41
CHO _{ox} (g.min ⁻¹)	3.48 (0.55)	3.47 (0.51)	3.91 (0.56)	3.81 (0.55)	0.89, 0.046	0.18, 0.54
Fat _{ox} (g.min ⁻¹)	0.06 (0.22)	0.01 (0.18)	0.16 (0.10)	0.14 (0.11)	0.25, 0.42	0.24, 0.46
B[glc] (mmol.L ⁻¹)	4.76 (0.51)	5.00 (0.43)	4.89 (0.33)	5.05 (0.57)	0.10, -0.62	0.40, -0.32
B[la] (mmol.L ⁻¹)	4.68 (2.01)	4.53 (1.60)	3.59 (0.97)	4.30 (1.70)	0.63, 0.17	0.16, -0.55
V _E (L.min ⁻¹)	78.36 (9.97)	84.21 (8.26)	80.04 (9.10)	81.22 (9.14)	<0.001, -1.88	0.28, -0.41
RR (breaths.min ⁻¹)	38.91 (6.33)	40.39 (6.84)	38.75 (6.60)	39.40 (6.35)	0.10, -0.62	0.46, -0.27

Ventilation
PF < PL

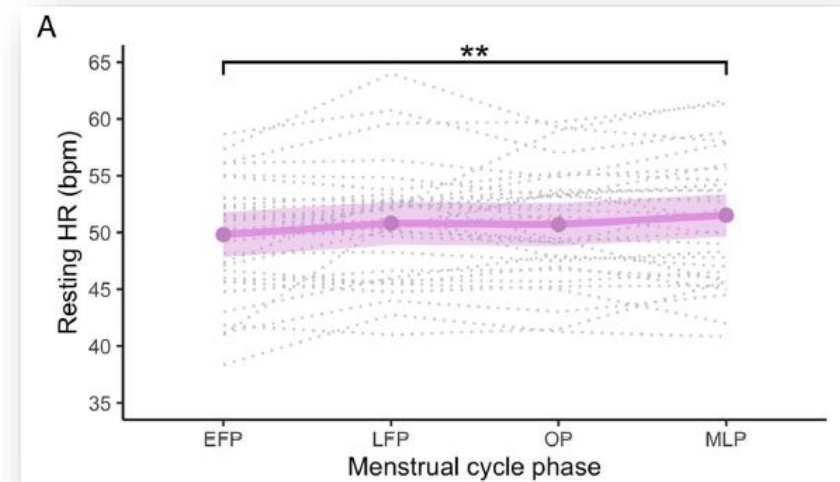
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psychologiques, biomécaniques, physiologiques



Système cardio-respiratoire



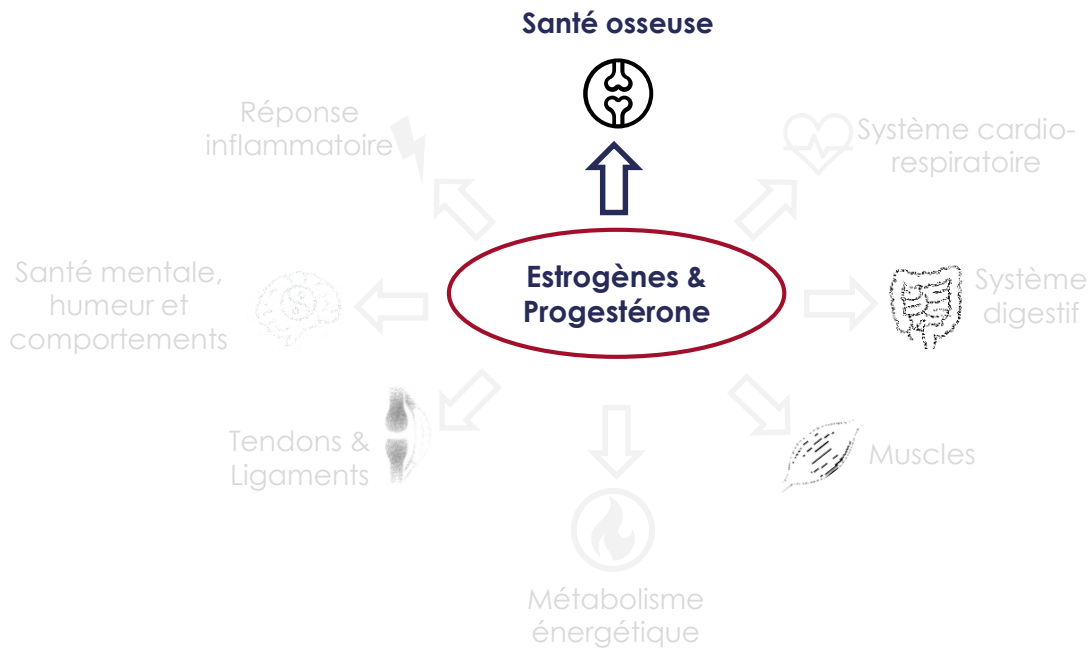
FC de repos

PF < PL

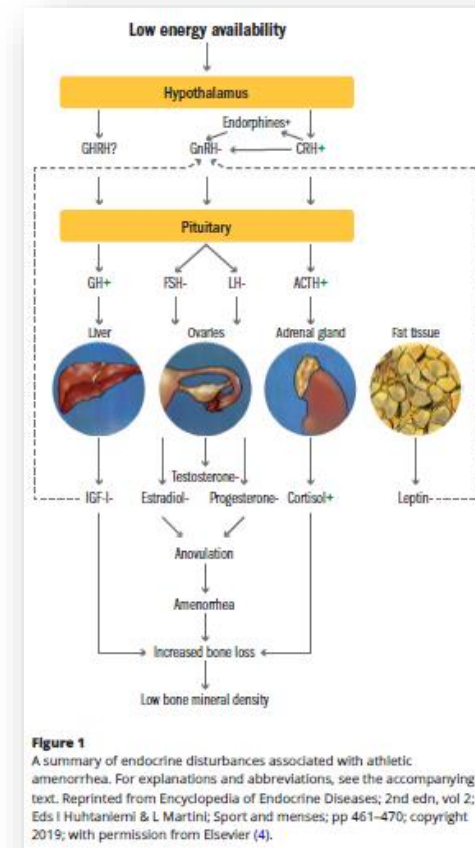
Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E_2 et P) vont impacter de nombreux systèmes **psychologiques, biomécaniques, physiologiques**



Santé osseuse



LEA

Triade de l'athlète



Taux d' E_2 insuffisant

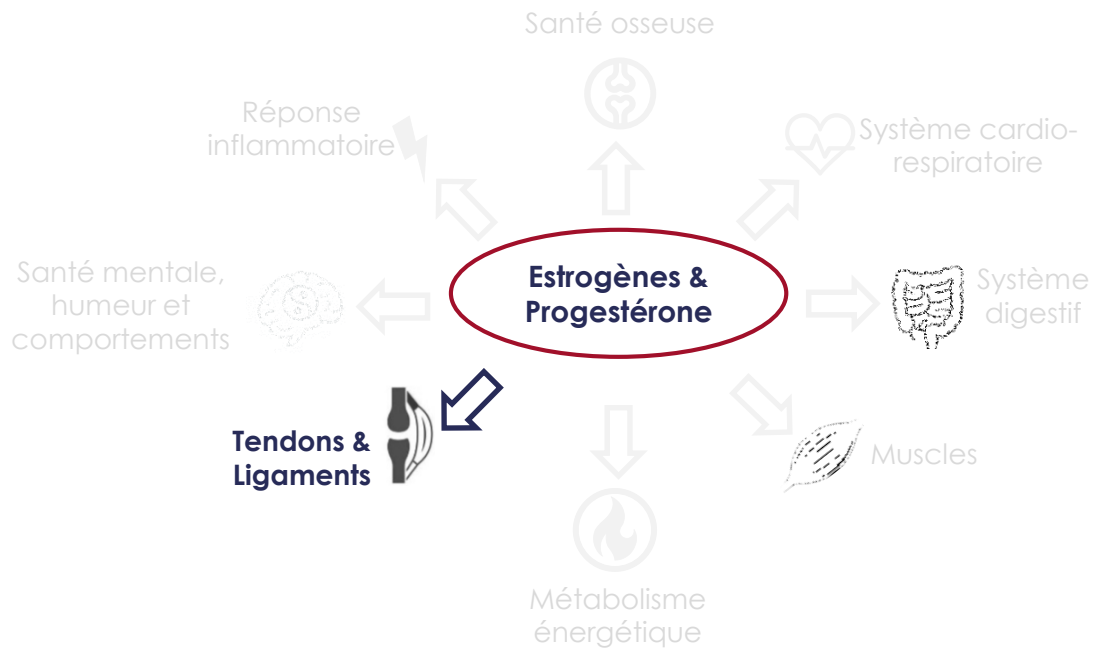


Ostéoporose précoce
↗ Risque de fracture de fatigue

Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E_2 et P) vont impacter de nombreux systèmes
psychologiques, biomécaniques, physiologiques



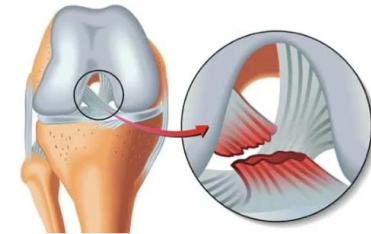
Tendons & ligaments

Compliance de tissus mou
Tolérance à la charge mécanique
Laxité des ligaments
Fonction neuromusculaire

Fin folliculaire (période péri-ovulatoire) < Début folliculaire ou Fin lutéale



↗ **Risque de blessures**

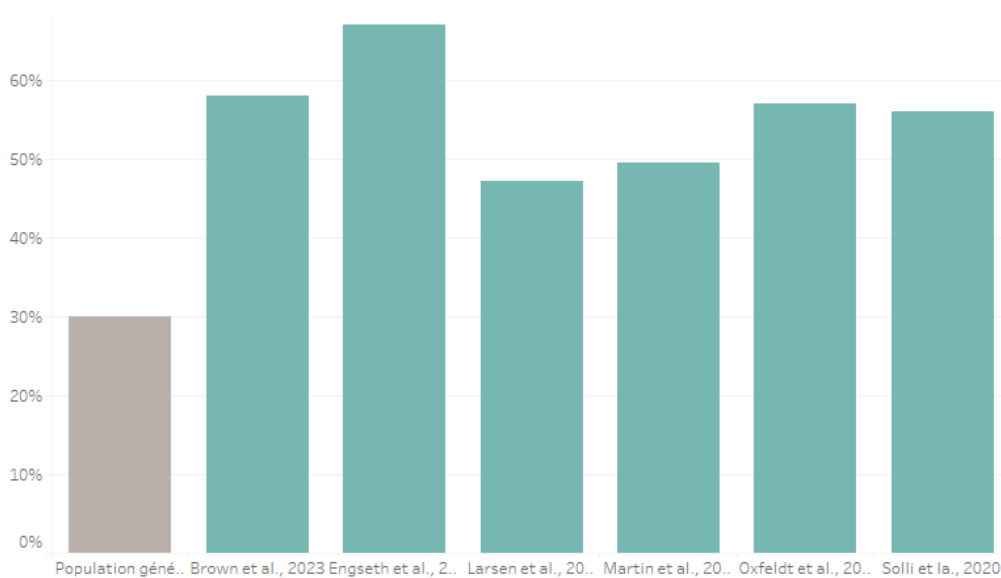


Spécificités féminines : physiologie & variations hormonales

La contraception hormonale




30% vs 47-67 %



Les raisons :

- Contraception
- Limitation / diminution des symptômes menstruels
- Maîtrise / gestion des cycles

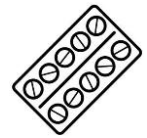
“
The very few conclusions we have about effects of the menstrual cycle on athletic performance in normally menstruating women cannot be applied to women on hormonal contraception who do not have the same cycling pattern due to their exogenous hormones.
”



-Dr. Kathryn Ackerman

Spécificités féminines : physiologie & variations hormonales

La contraception hormonale



→ Les pilules
« oestro-progestatives » ou « combinées »
« progestatives »
Quantités d'hormones délivrées variables



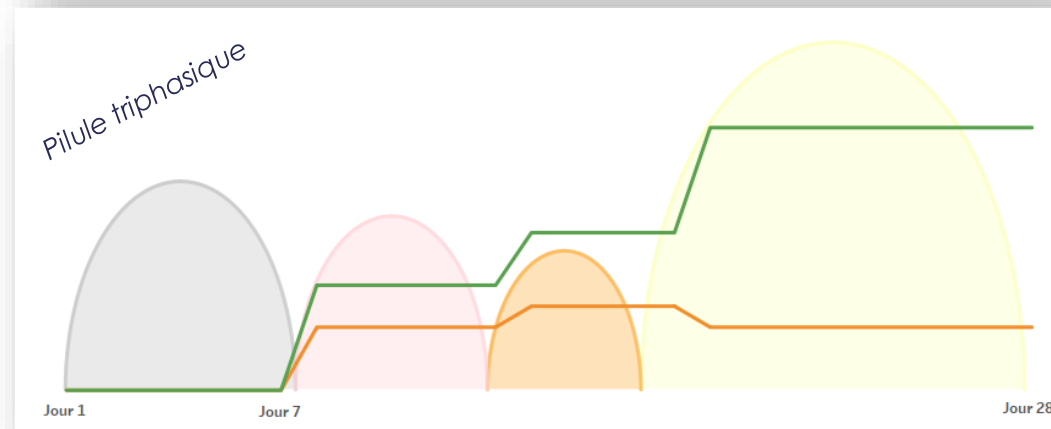
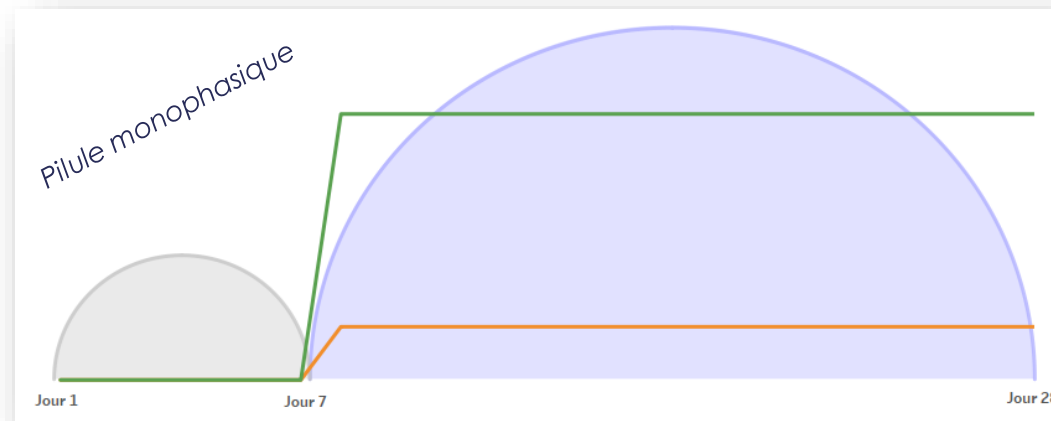
→ Les patches et les anneaux vaginaux
Même fonctionnement que les pilules



→ Les implants et les injections

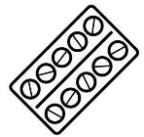


→ Les stérilets hormonaux
= « Intra Uterine Device »
≠ stérilet en cuivre



Spécificités féminines : physiologie & variations hormonales

La contraception hormonale



→ Les pilules
« oestro-progestatives » ou « combinées »
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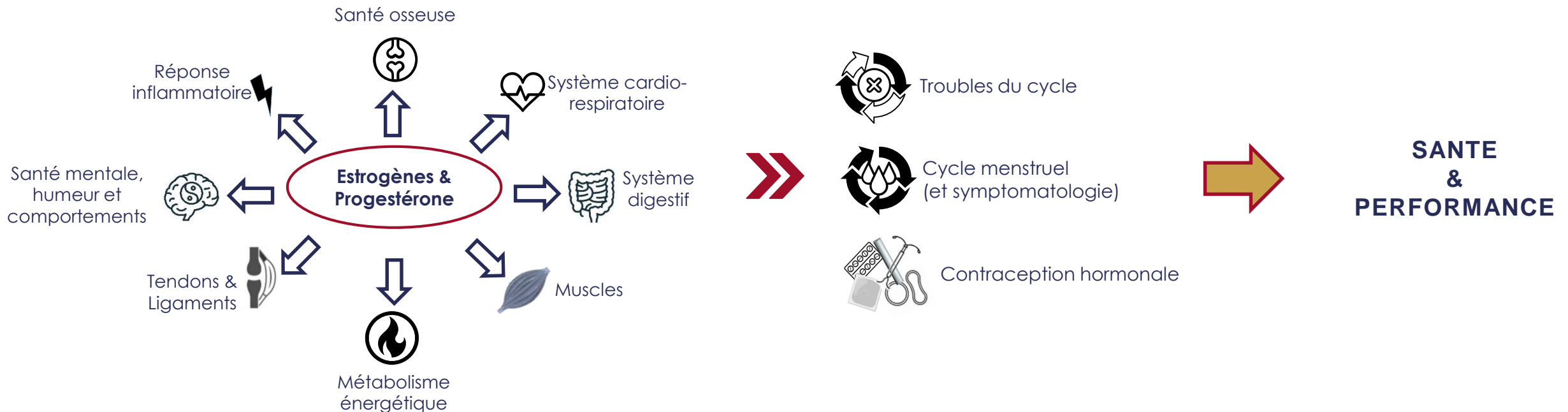
Régulation à la baisse de la production des hormones endogènes



Spécificités féminines : physiologie & variations hormonales

Hormones et impacts physiologiques

Les hormones sexuelles (E_2 et P) vont impacter de nombreux systèmes
psychologiques, biomécaniques, physiologiques



Spécificités féminines : physiologie & variations hormonales

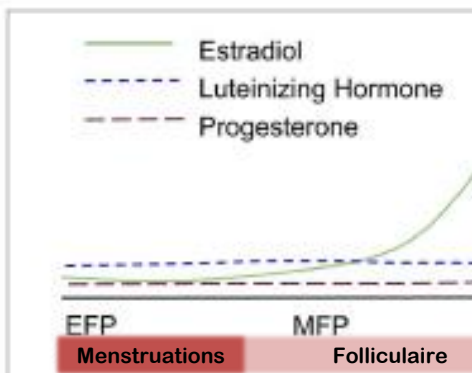
Hormones et impacts physiologiques

Saignements très abondants (= ménorragie)

La dysménorrhée

Le syndrome prémenstruel

Le trouble dysphorique prémenstruel



⚠
⇒ Période « à risque » d'anémie

✓ Perte de sang entre 5 et 80mL

Spécificités féminines : physiologie & variations hormonales

Impact sur la santé et la performance

> [Aviat Space Environ Med.](#) 1990 Jul;61(7):657-9.

Relationship of menstrual history to altitude chamber decompression sickness

F W Rudge ¹

Multicenter Study > [Med Lav.](#) 2015 Jan 9;106(1):17-22.

Occupational accidents among attendants inside hyperbaric chambers in France

Richard Pougnet ¹, Anne Henckes, Laurence Pougnet, Guy Cochard, Françoise Dantec, Jean-Dominique Dewitte, Brice Loddé

Decompression sickness in women: a possible relationship with the menstrual cycle

Vivienne Lee ¹, Marguerite St Leger Dowse, Christopher Edge, Alex Gunby, Philip Bryson

Gender not a factor for altitude decompression sickness risk

James T Webb ¹, Nandini Kannan, Andrew A Pilmanis

> [J Obstet Gynaecol.](#) 2006 Apr;26(3):216-21. doi: 10.1080/01443610600555261.

Problems associated with scuba diving are not evenly distributed across a menstrual cycle

M St Leger Dowse ¹, A Gunby, D Phil, R Moncad, C Fife, J Morsman, P Bryson

- ❖ Femmes plus sensibles aux accidents de décompression lorsqu'elles plongent pendant leurs règles
- ❖ Plus grandes proportion d'accidents de décompression la première semaine du cycle
- ❖ Corrélation possible entre l'incidence des accidents de décompression et la phase du cycle dans laquelle ils surviennent

Spécificités féminines : physiologie & variations hormonales

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Occupational accidents among attendants inside hyperbaric chambers in France

Richard Pougnet ¹, Anne Henckes, Laurence Pougnet, Guy C...
Jean-Dominique Dewitte, Brice Loddé

Decompression sickness: relationship with menstrual cycle

Vivienne... Alex Gunby, Philip Bryson

**Résultats peu significatifs
Nombreux biais méthodologiques**

- ❖ Femmes plus sensibles aux accidents de décompression lorsqu'elles plongent pendant leurs règles
- ❖ Plus grandes proportions d'accidents de décompression la première semaine du cycle
- ❖ Corrélation possible entre l'incidence des accidents de décompression et la phase du cycle dans laquelle ils surviennent

Ne permet pas de formuler des recommandations particulières en fonction des phases du cycle

> J Obstet G

Problem... distributed across a menstrual cycle

M St Leger Dowse ¹, A Gunby, D Phil, R Moncad, C Fife, J Morsman, P Bryson

Spécificités féminines : physiologie & variations hormonales

Impact sur la santé et la performance

Current evidence shows no influence of women's cycle phase on performance resistance

Effects of the menstrual cycle phase on anterior cruciate ligament neuromuscular and biomechanical injury risk surrogates in eumenorrheic and naturally menstruating women: A systematic review

BRIEF REVIEW
Exercise-Induced Systemic Inflammation
Romero-Parra, Nuria; Clifton, David
on behalf of the IronFFMMI

Thomas Dos'Santos^{1,2}, Georgina K Stebbings^{1,2}, Christopher Morse^{1,2}, Medha Shashidharan^{1,2}, Katherine A J Daniels^{1,2}, Andy Sanderson^{1,2}

The Influence of Menstrual-Cycle Phase on Measures of Recovery Status in Endurance Athletes: The Female Endurance Athlete Project

Virginia De Martin Topranin,¹ Tina Pettersen Engseth,² Maria Hrozanova,¹ Madison Taylor,² Øyvind Sandbakk,^{1,2} and Dionne A. Noordhof¹

¹Center for Elite Sports Research, Department of Neuromedicine and Movement Science (INB), Faculty of Medicine and Health Sciences, Norwegian University of Science and Technology, Trondheim, Norway; ²School of Sport Sciences, UiT Arctic University of Norway, Tromsø, Norway

Purpose: To investigate the influence of menstrual-cycle (MC) phase on measures of recovery status, that is, resting heart rate, perceived sleep quality, and physical and mental readiness to train, among female endurance athletes. **Methods:** Daily data were recorded during 1 to 4 MCs (ie, duration ≥ 21 and ≤ 35 d, ovulatory, luteal phase ≥ 10 d) of 41 trained-to-elite-level female endurance athletes (mean [SD]: age 27 [8] y, weekly training: 9 [3] h). Resting heart rate was assessed daily using a standardized protocol, while perceived sleep quality and physical and mental readiness to train were assessed using a visual analog scale (1–10). Four MC phases (early follicular phase [EFP], late follicular phase, ovulatory phase, and midluteal phase [MLP]) were determined using the calendar-based counting method and urinary ovulation-prediction test. Data were analyzed using linear mixed-effects models. **Results:** Resting heart rate was significantly higher in MLP (1.7 beats·min⁻¹, $P = .006$) compared with EFP without significant differences between the other MC phases. Perceived sleep quality was impaired in MLP compared with late follicular phase (-0.3 , $P = .035$). Physical readiness to train was lower both in ovulatory phase (-0.6 , $P = .015$) and MLP (-0.5 , $P = .026$) compared with EFP. Mental readiness to train did not show any significant differences between MC phases ($P > .05$). **Conclusions:** Although significant, the findings had negligible to small effect sizes, indicating that MC phase is likely not the main determinant of changes in measures of recovery status but, rather, one of the many possible stressors.

contact ACL injury risk based on neuromuscular and biomechanical surrogates. Practitioners should be cautious manipulating their physical preparation, injury mitigation, and screening practises based on current evidence. Although variable (i.e., magnitude and direction), MC attributed changes in knee laxity were associated with changes in potentially hazardous KJLs. Monitoring knee laxity could therefore be a viable strategy to infer possible ACL injury risk.

Spécificités féminines : physiologie & variations hormonales

Impact sur la santé et la performance

Current evidence shows no influence of women's menstrual cycle phase on performance or resistance

BRIEF REVIEW
Exercise-Induced Fatigue: A Systematic Review
Romero-Parra, Nuria C
Journal of Strength & Conditioning Research

Effects of the menstrual cycle phase on anterior cruciate ligament neuromuscular and biomechanical injury risk surrogates in eumenorrheic and naturally menstruating women: A systematic review

Thomas Dos Santos^{1, 2}, Georgina K Stebbings^{1, 2}, Christopher Morse^{1, 2}, Medha Shashidharan^{1, 2}, Katherine A J Daniels^{1, 2}, Andy Sanderson^{1, 2}

The Influence of Menstrual-Cycle Phase on Measures of Recovery Status in Endurance Athletes: The Female Endurance Athlete Project

Virginia De Maesseneer¹

¹ Madison Taylor,²

Divergence entre les études
Effets minimes
Pas d'évidence

¹Center for Elite Sport Science, Norwegian University of Science and Technology

²Department of Medicine and Health Sciences, Norwegian University of Science and Technology, Tromsø, Norway

Purpose: To investigate the influence of menstrual cycle phase on measures of recovery status, that is, resting heart rate, perceived sleep quality, physical and mental readiness to train, among female endurance athletes. **Methods:** Daily data were recorded during 1 to 4 MCs (ie, duration ≥ 21 and ≤ 35 d, ovulatory, luteal phase ≥ 10 d) of 41 trained-to-elite-level female endurance athletes (mean [SD]: age 27 [8] y, weekly training: 9 [3] h). Resting heart rate was assessed daily using a standardized protocol, while perceived sleep quality and physical and mental readiness to train were assessed using a visual analog scale (1–10). Four MC phases (early follicular phase [EFP], late follicular phase, ovulatory phase, and midluteal phase [MLP]) were determined using the calendar-based counting method and urinary ovulation-prediction test. Data were analyzed using linear mixed-effects models. **Results:** Resting heart rate was significantly higher in MLP (1.7 beats·min⁻¹, $P = .006$) compared with EFP without significant differences between the other MC phases. Perceived sleep quality was impaired in MLP compared with late follicular phase (-0.3 , $P = .035$). Physical readiness to train was lower both in ovulatory phase (-0.6 , $P = .015$) and MLP (-0.5 , $P = .026$) compared with EFP. Mental readiness to train did not show any significant differences between MC phases ($P > .05$). **Conclusions:** Although significant, the findings had negligible to small effect sizes, indicating that MC phase is likely not the main determinant of changes in measures of recovery status but, rather, one of the many possible stressors.

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Spécificités féminines : physiologie & variations hormonales

Current evidence shows no influence of women's menstrual cycle phase on performance or resistance

BRIEF REVIEW

Exercise-Induced Fatigue: A Systematic Review

Romero-Parra, Nuria; Cordero, María; ...

Effects of the menstrual cycle phase on anterior cruciate ligament neuromuscular and biomechanical injury risk surrogates in eumenorrheic and naturally menstruating women: A systematic review

Thomas Dos Santos^{1, 2}, Georgina K. Stebbings^{1, 2}, Christopher Morse^{1, 2}, Medha Shashidharan^{1, 2}, Katherine A.J. Daniels^{1, 2}, Andy Sanderson^{1, 2}

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Virginia De Maesseneire¹

Madison Taylor,²

Divergence entre les études
Effets minimes
Pas d'évidence

¹Center for Elite Sport Science, Norwegian University of Sport and Physical Education

²Department of Medicine and Health Sciences, University of Tromsø, Norway

Purpose: To investigate the influence of menstrual cycle phase on measures of recovery status, that is, resting heart rate, perceived sleep quality, mood, and mental readiness to train, among female endurance athletes. **Methods:** Daily data were recorded during 1 to 4 MCs (ie, duration ≥ 21 and ≤ 35 d, ovulatory, luteal phase ≥ 10 d) of 41 trained-to-elite-level female endurance athletes (mean [SD]: age 27 [8] y, weekly training: 9 [3] h). Resting heart rate was assessed daily using a standardized protocol, while perceived sleep quality and physical and mental readiness to train were assessed using a visual analog scale (1–10). Four MC phases (early follicular phase [EFP], late follicular phase, ovulatory phase, and midluteal phase [MLP]) were determined using the calendar-based counting method and urinary ovulation-prediction test. Data were analyzed using linear mixed-effects models. **Results:** Resting heart rate was significantly higher in MLP (1.7 beats·min⁻¹, $P = .006$) compared with EFP without significant differences between the other MC phases. Perceived sleep quality was impaired in MLP compared with late follicular phase (-0.3 , $P = .035$). Physical readiness to train was lower both in ovulatory phase (-0.6 , $P = .015$) and MLP (-0.5 , $P = .026$) compared with EFP. Mental readiness to train did not show any significant differences between MC phases ($P > .05$). **Conclusions:** Although significant, the findings had negligible to small effect sizes, indicating that MC phase is likely not the main determinant of changes in measures of recovery status but, rather, one of the many possible stressors.

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Impact sur la santé et la performance

The Effects of Oral Contraceptives on Exercise Performance in Women: A Systematic Review and Meta-analysis

Kirsty J. Elliott-Sale¹, Kelly L. McNulty², Paul Ansdell², Stuart Goodall², Kirsty M. Hicks², Kevin Thomas², Paul A. Swinton³, Eimear Dolan⁴

Published online: 14 July 2020
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Abstract

Background Oral contraceptive pills (OCPs) are double agents, which downregulate endogenous concentrations of oestradiol and progesterone whilst simultaneously providing daily supplementation of exogenous oestrogen and progestin during the OCP-taking days. This altered hormonal milieu differs significantly from that of eumenorrheic women and might impact exercise performance, due to changes in ovarian hormone-mediated physiological processes.

Objective To explore the effects of OCPs on exercise performance in women and to provide evidence-based performance recommendations to users.

Methods This review complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A between-group analysis was performed, wherein performance of OCP users was compared with naturally menstruating women, and a within-group analysis was conducted, wherein performance during OCP consumption was compared with OCP withdrawal. For the between-group analysis, women were phase matched in two ways: (1) OCP withdrawal versus the early follicular phase of the menstrual cycle and (2) OCP consumption versus all phases of the menstrual cycle except for the early follicular phase. Study quality was assessed using a modified Downs and Black Checklist and a strategy based on the recommendations of the Grading of Recommendations Assessment Development and Evaluation working group. All meta-analyses were conducted within a Bayesian framework to facilitate probabilistic interpretations.

Results 42 studies and 590 participants were included. Most studies (83%) were graded as moderate, low or very low quality, with 17% achieving high quality. For the between-group meta-analysis comparing OCP users with naturally menstruating women, posterior estimates of the pooled effect were used to calculate the probability of at least a small effect ($d \geq 0.2$). Across the two between-group comparison methods, the probability of a small effect on performance favouring habitual OCP users was effectually zero ($p < 0.001$). In contrast, the probability of a small effect on performance favouring naturally menstruating women was moderate under comparison method (1) ($d \geq 0.2$; $p = 0.40$) and small under comparison method (2) ($d \geq 0.2$; $p = 0.19$). Relatively large between-study variance was identified for both between-group comparisons ($\tau_{0.5} = 0.16$ [95% credible interval (CrI) 0.01–0.44] and $\tau_{0.5} = 0.22$ [95% CrI 0.06–0.45]). For the within-group analysis comparing OCP consumption with withdrawal, posterior estimates of the pooled effect size identified almost zero probability of a small effect on performance in either direction ($d \geq 0.2$; $p \leq 0.001$).

Conclusions OCP use might result in slightly inferior exercise performance on average when compared to naturally menstruating women, although any group-level effect is most likely to be trivial. Practically, as effects tended to be trivial and variable across studies, the current evidence does not warrant general guidance on OCP use compared with non-use. Therefore, when exercise performance is a priority, an individualised approach might be more appropriate. The analysis also indicated that exercise performance was consistent across the OCP cycle.

Spécificités féminines : physiologie & variations hormonales

Current evidence shows no influence of women's menstrual cycle phase on exercise performance or resistance

BRIEF REVIEW
Exercise-Induced Fatigue: A Systematic Review
Romero-Parra, Nuria; Cordero, Juan; Ferraz, Fernando

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Impact sur la santé et la performance

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Published online: 14 July 2020
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Abstract

Background Oral contraceptive pills (OCPs) are double agents, which downregulate endogenous concentrations of oestradiol and progesterone, and supplement exogenous oestrogen and progesterone during the menstrual cycle. OCP-taking may affect exercise performance in women and might impact on exercise-based performance. Objective To determine the effects of OCP use on exercise performance. Methods A between-group analysis comparing naturally menstruating women, and a within-group analysis comparing OCP withdrawal versus the early follicular phase of the menstrual cycle and (2) OCP consumption versus all phases of the menstrual cycle.

The Influence of Menstrual-Cycle Phase on Measures of Recovery Status in Endurance Athletes: The Female Endurance Athlete Project

Virginia De Maessenecker¹

Madison Taylor²

Divergence entre les études
Effets minimes
Pas d'évidence

Peu d'études
Effets minimes
Pas d'évidence

Ne justifie pas de périodiser l'entraînement en fonction du cycle hormonal MAIS...

Purpose: To investigate the influence of menstrual cycle phase on measures of recovery status, that is, resting heart rate, perceived sleep quality, mood, and mental readiness to train, among female endurance athletes. Methods: Daily data were recorded during 1 to 4 weeks in naturally menstruating women and in women using oral contraceptive pills (OCP). Results: Resting heart rate was significantly higher in MLP (1.7 beats·min⁻¹; P = .006) compared with EFP without significant differences between the other MC phases. Perceived sleep quality was impaired in MLP compared with late follicular phase (-0.3, P = .035). Physical readiness to train was lower both in ovulatory phase (-0.6, P = .015) and MLP (-0.5, P = .026) compared with EFP. Mental readiness to train did not show any significant differences between MC phases (P > .05). Conclusions: Although significant, the findings had negligible to small effect sizes, indicating that MC phase is likely not the main determinant of changes in measures of recovery status but, rather, one of the many possible stressors.

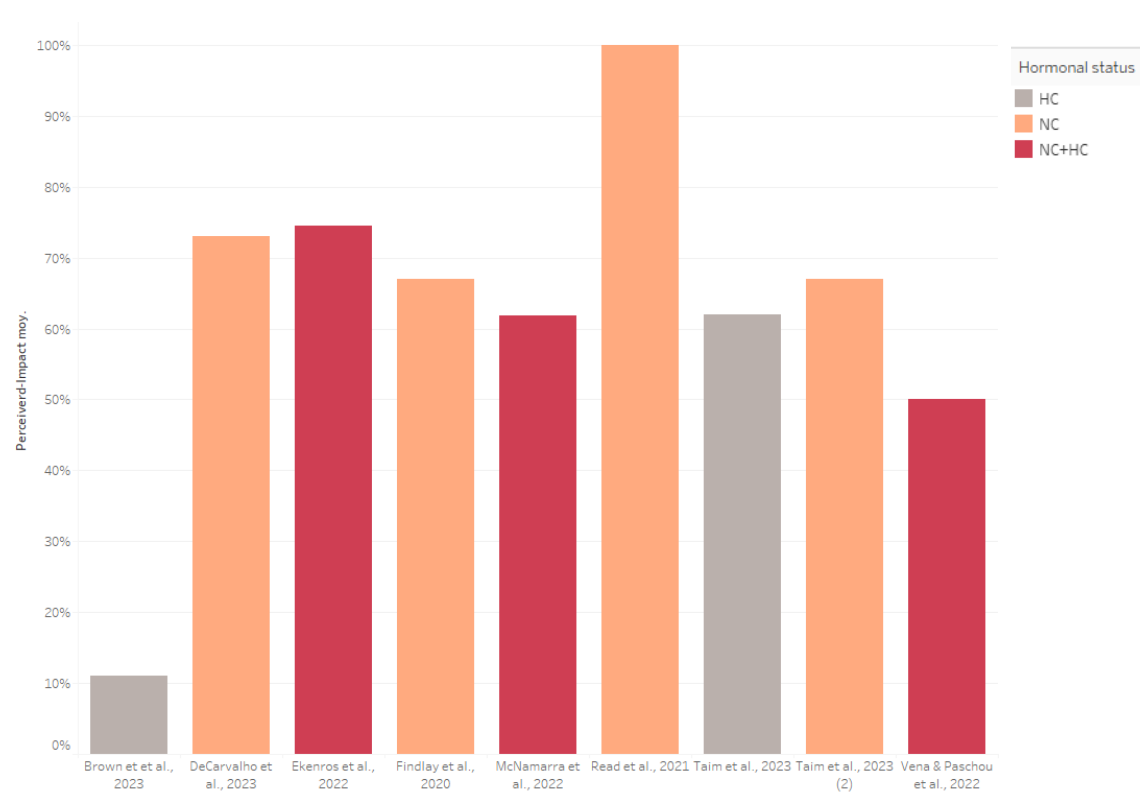
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Conclusion: OCP use might result in slightly inferior exercise performance on average when compared to naturally menstruating women, although any group-level effect is most likely to be trivial. Practically, as effects tended to be trivial and variable across studies, the current evidence does not warrant general guidance on OCP use compared with non-use. Therefore, when exercise performance is a priority, an individualised approach might be more appropriate. The analysis also indicated that exercise performance was consistent across the OCP cycle.

Spécificités féminines : physiologie & variations hormonales

Impact sur la santé et la performance

% d'athlètes percevant un impact de leurs cycles hormonaux sur leur bien-être et/ou performance à l'entraînement et/ou compétition



Etude sur 400 plongeuses

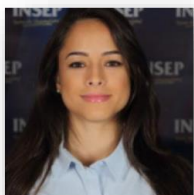
64% plongent pendant leurs règles

48% estiment que leur compétences sont moins bonnes

15% estiment que leurs performances sont modifiées

Données issues de la conférence du Dr Bernard Bailleux (2018)

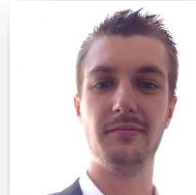
- Manque d'études « de qualité »**
(méthodologie : détermination des phases)
- Laboratoire ≠ Terrain**
- Masque les variations inter-individuelles**



**Juliana
Antero**



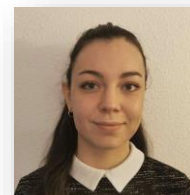
**Tom
Chassard**



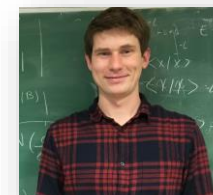
**Steven
Golovkine**



**Alice
Lafitte**



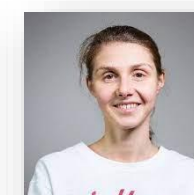
**Nolwenn
Badier**



**Florent
Storme**



**Hugo
Carlin**



**Marine
Dupuit**



FFAVIRON
10 athlètes
3 para-athlètes



12 athlètes



12 athlètes



1 athlète



14 athlètes



7 athlètes



23 joueuses



15 athlètes



9 athlètes

Collaborations:

Carole Maître, Gynécologue (Dép. Med INSEP)

Martine Duclos, Endocrinologue (Univ. Clermont Auvergne)



Déterminer l'influence des **phases hormonales** sur la réponse à la **charge d'entraînement** et sur le **bien-être**

RECHERCHE

&

ACCOMPAGNEMENT

- Observer les **profil hormonaux** et la **dynamique des variations hormonales**.
 - Visualiser la variation des **réponses à la charge d'entraînement en fonction du cycle**.
 - Comprendre **l'effet de ces variations** hormonales sur le bien-être, la réponse à la charge d'entraînement et sur la performance
- **Dialoguer** autour des questions liées aux cycles menstruels, lever des éventuels tabous.
 - **Connaitre** son profil hormonal et les dynamiques des variations hormonales.
 - Mieux **appréhender** et **gérer les effets du cycle** menstruel sur la performance





Fu Yuanhui (JO RIO 2016)



« Je n'ai pas des compétences pour tirer des conclusions sur le lien entre la menstruation et les blessures, mais j'encourage les personnes qualifiées à nous donner des réponses »

Estelle Nze Minko, L'EQUIPE, 12 mai 2020



Dina Asher-Smith (2022)



Renelle Lamote (2023)

The Guardian

How period tracking can give all female athletes an edge

The adviser to the US' women's World Cup winners shows them how to train with their menstrual cycle, not against it - and there are lessons for the rest of us



A whole new ball game ... the all-conquering US women, who employed a menstrual cycle adviser. Photograph: Brad Smith/ISI/Rex/Shutterstock

The Telegraph Coronavirus News Politics Sport Business Money Opinion Tech Life Style Tra

Football Rugby Union Cricket Formula 1 Women's Sport Cycling Tennis Golf

Sport World Cup

Ending period 'taboo' gave USA marginal gain at World Cup

share Save 2



Rose Lavelle (top) scored the goal that confirmed the United States' World Cup triumph CREDIT: GETTY IMAGES

JUST WOMEN'S SPORTS NWSL WNBA NCAAW USWNT SNACKS MORE

Euros 2022: England players track menstrual cycles to gain edge on field



The secret to England's record-breaking Euros campaign? Period power

For months, Millie Bright has meticulously tracked her menstrual cycle, so she can make better informed decisions around her training

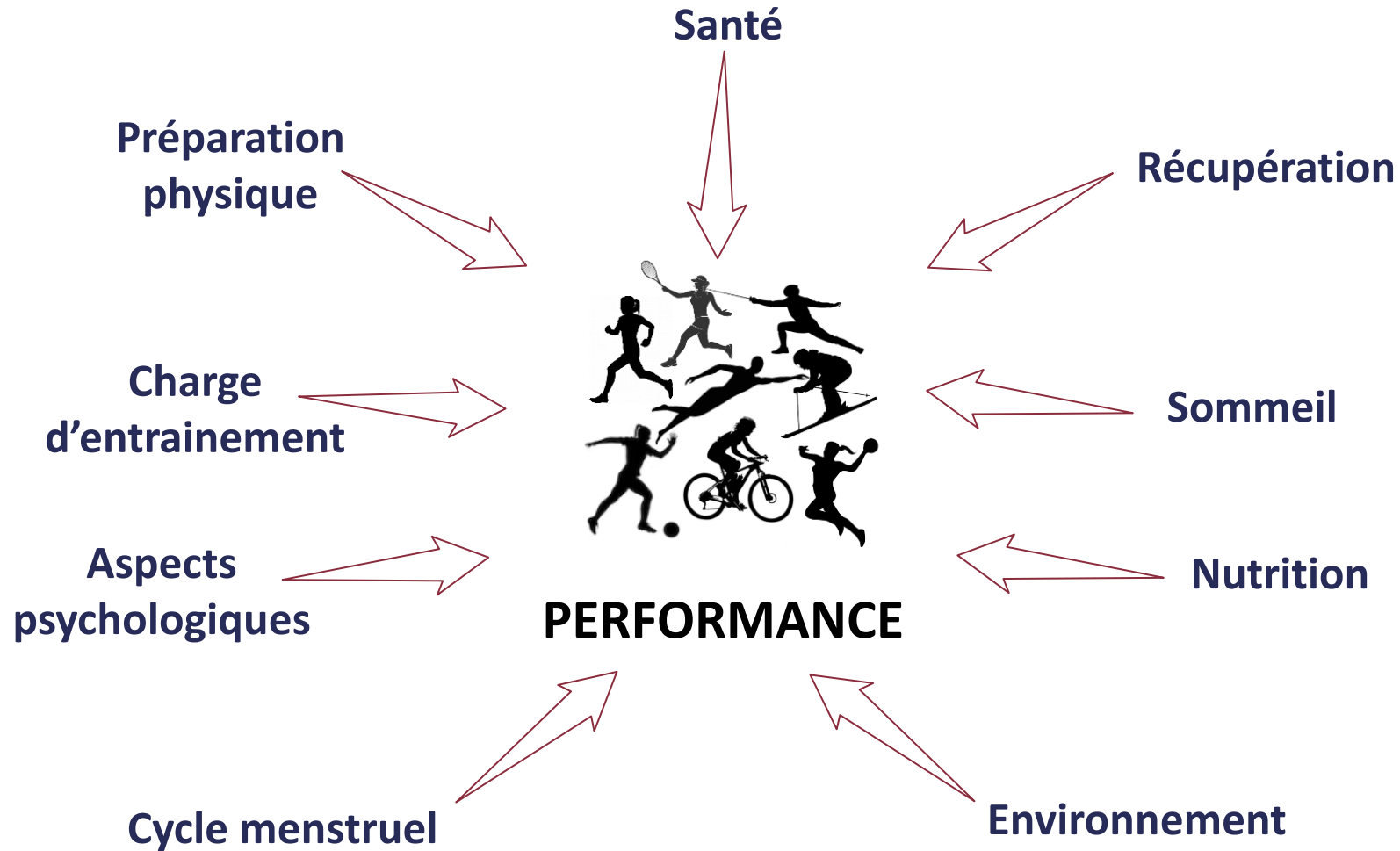
LE FIGARO - SPORT

FOOTBALL : CHELSEA ADAPTE SES ENTRAÎNEMENTS AUX CYCLES MENSTRUELS DE SES JOUEUSES





Un paramètre de la performance à prendre en considération





Le « gold standard » : une combinaison de 3 méthodes

Méthode
calendaire








Test
d'ovulation



Dosage des
[hormones]_{pl}



Methodological Considerations for Studies in Sport and Exercise Science with Women as Participants: A Working Guide for Standards of Practice for Research on Women

Kirsty J. Elliott-Sale¹  · Clare L. Minahan²  · Xanne A. K. Janse de Jonge³  · Kathryn E. Ackerman⁴  · Sarianna Sipilä⁵  · Naama W. Constantini⁶ · Constance M. Lebrun⁷ · Anthony C. Hackney⁸



Le « gold standard » : une combinaison de 3 méthodes

Méthode
calendaire



Test
d'ovulation



Dosage des
[hormones]_{pl}



Difficultés à long termes sur le terrain avec des athlètes HN

A adapter selon l'objectif et les ressources

International Journal of Sports Physiology and Performance, (Ahead of Print)
<https://doi.org/10.1123/ijsp.2022-0287>
First Published Online: Sept. 4, 2023

Human Kinetics 
ORIGINAL INVESTIGATION

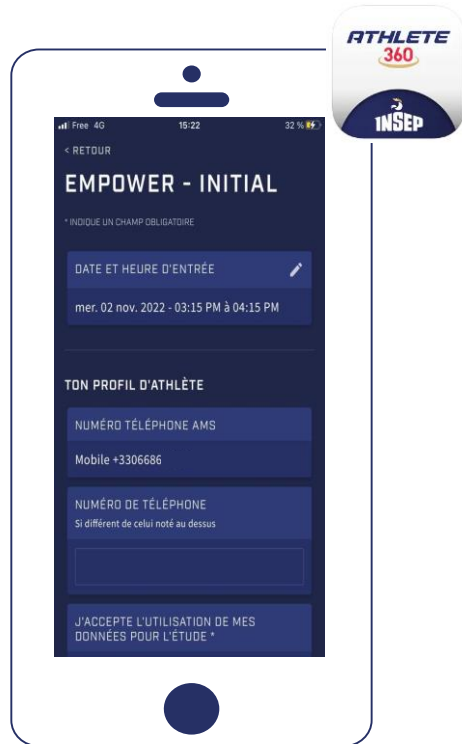
On-Field Methodological Approach to Monitor the Menstrual Cycle and Hormonal Phases in Elite Female Athletes

Marine Dupuit,^{1,2} Alice Meignié,² Tom Chassard,² Ludivine Blanquet,² Julien LeHeran,³
Thomas Delaunay,³ Elise Bernardeau,³ Jean-François Toussaint,^{2,4,5} Martine Duclos,^{6,7}
and Juliana Antero²

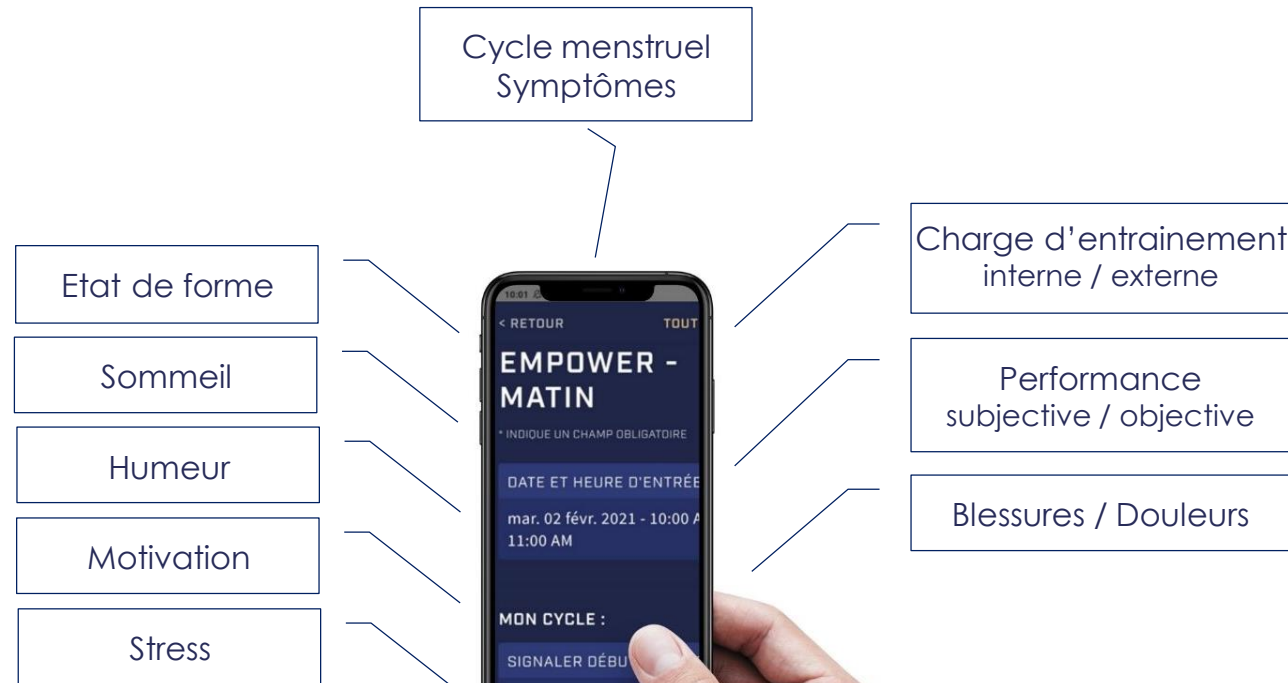
¹Laboratory of Metabolic Adaptations to Exercise Under Physiological and Pathological Conditions (AME2P), Université Clermont Auvergne (UCA), Clermont-Ferrand, France; ²Institute for Research in Medicine and Epidemiology of Sports (IRMES, EA7329), INSEP, Paris, France; ³Football Club de Nantes, Nantes, France; ⁴CIMS, Hôtel-Dieu, Assistance Publique—Hôpitaux de Paris, Paris, France; ⁵Université Paris Cité, Paris, France; ⁶Sport Medicine and Functional Explorations, University Hospital of Clermont-Ferrand (CHU), Clermont-Ferrand, France; ⁷Unité de Nutrition Humaine (UNH), Université Clermont Auvergne (UCA), INRA, Clermont-Ferrand, France

Objectives: Currently, there are no guidelines for implementing the monitoring of menstrual status, including the natural menstrual cycle (NC) or oral contraception (OC), in a sport setting. We aimed to provide a feasible, on-field methodological approach for monitoring NC and OC in female athletes. **Methods:** We developed a smartphone app with daily questionnaires to monitor both NC and OC phases in 19 elite female soccer players (23.7 [4.4] y) over 7 months. Adherence and compliance were evaluated. The NC and OC phases were based on calendar data to establish an individual menstrual profile for each athlete. **Results:** The initial questionnaire revealed that the vast majority of female players (80%) were interested in monitoring their menstrual status. The online monitoring yielded high athlete adherence (87.0% [14.2%]) with a slight decrease over the winter break and at the end of the championship, which necessitated adaptations to promote compliance. Monitoring identified the specific menstrual pattern of each athlete and highlighted large interindividual variability. **Conclusion:** This study assesses, for the first time, the interest of female players in monitoring their menstrual status. It provides a new methodological approach, as well as guidelines for optimizing on-field monitoring. It also anticipates some obstacles sport staff may encounter when trying to implement such follow-up. It is essential to better understand the menstrual profile of athletes and determine its potential impacts on well-being and performance.

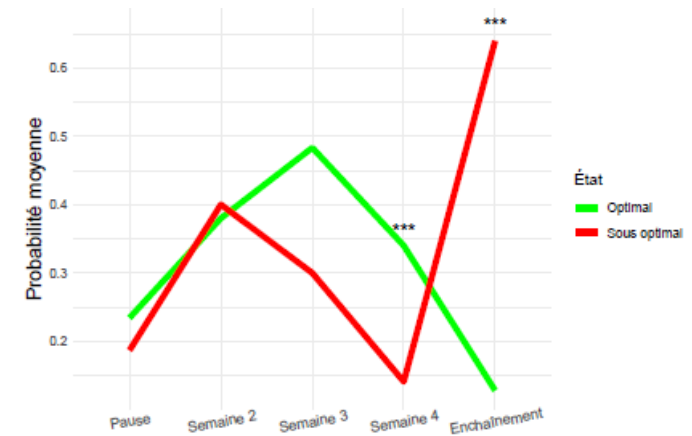
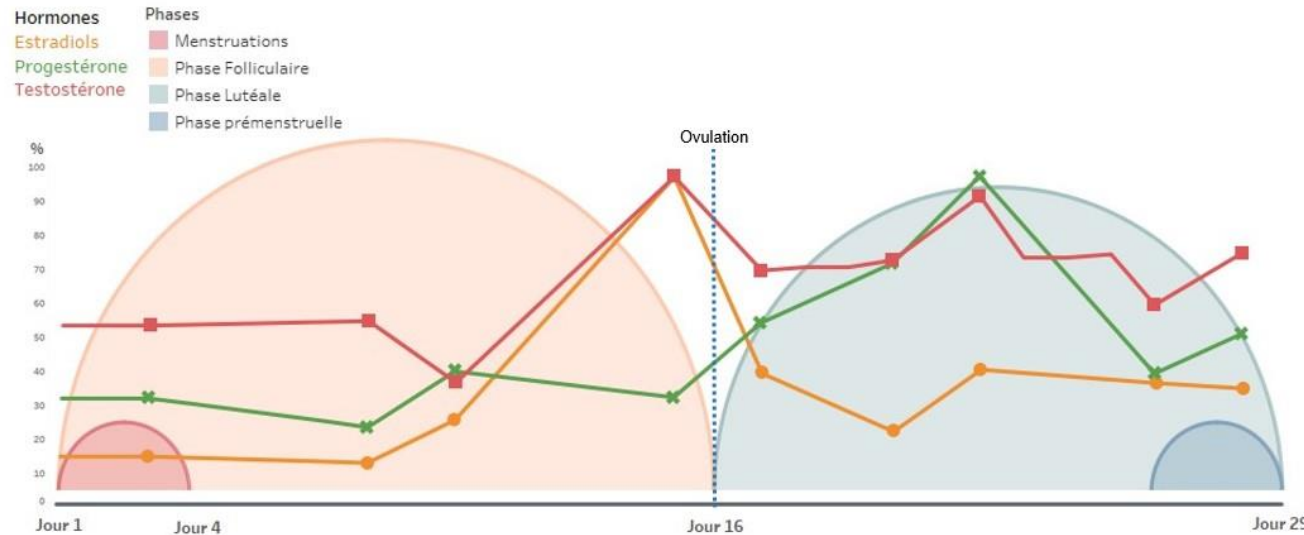
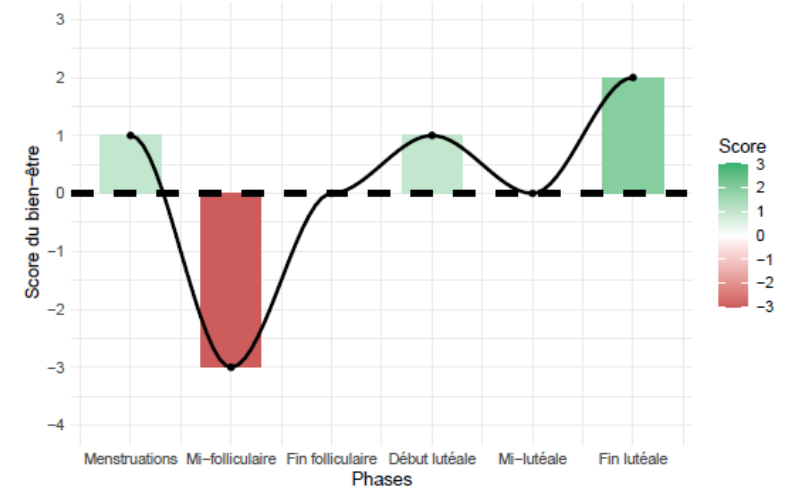
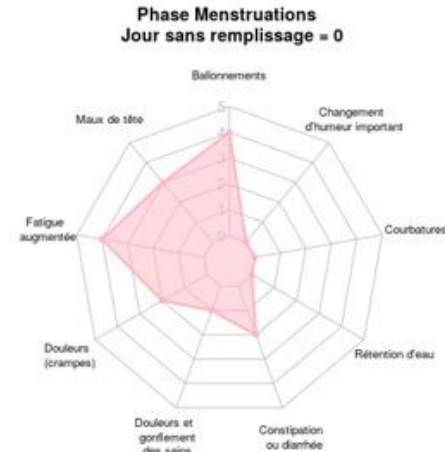
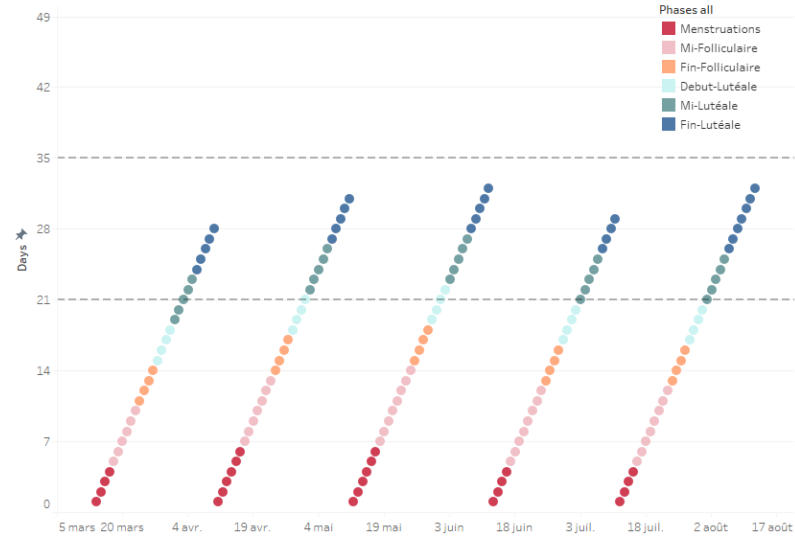
Keywords: menstrual status, monitoring, elite athlete, soccer, women



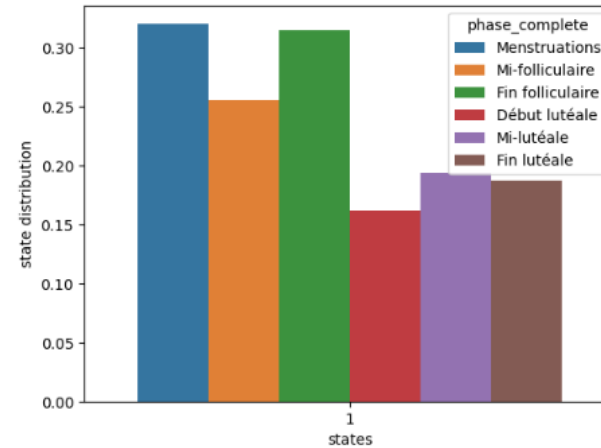
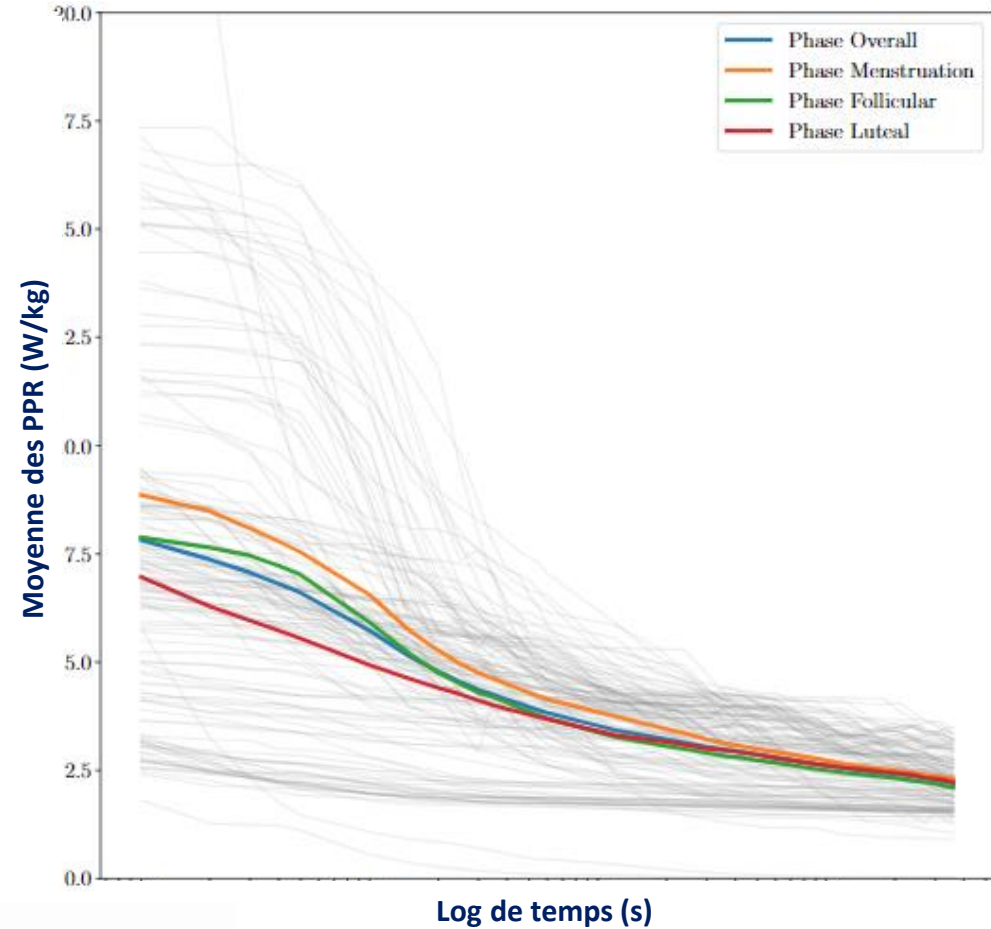
- Informations :
- démographiques,
 - sportives
 - sur le statut hormonal



CYCLES



N = 280 entrainements



Intérêt de planifier et/ou adapter les séances de haute intensité en fonction du cycle ?

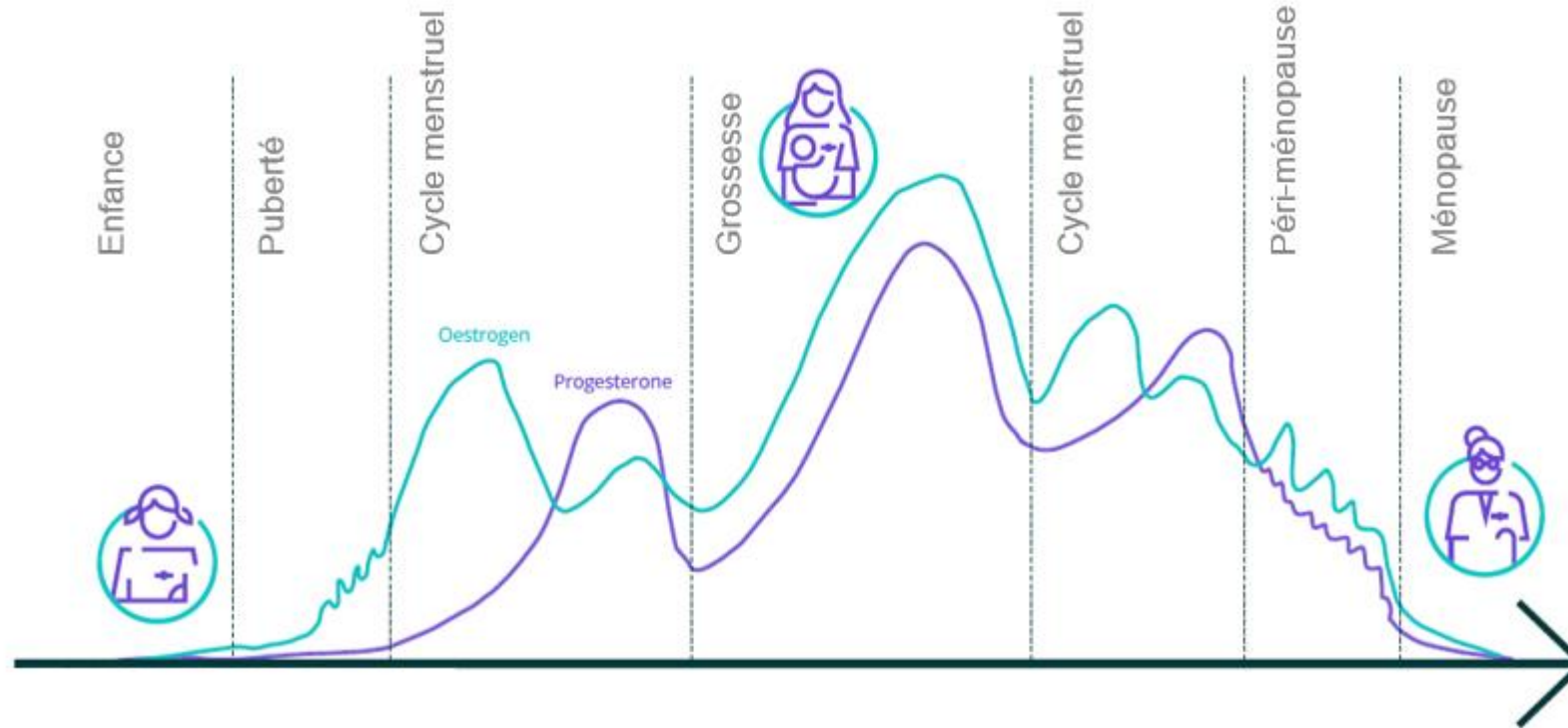


training_along_menstrual_cycle.mp4

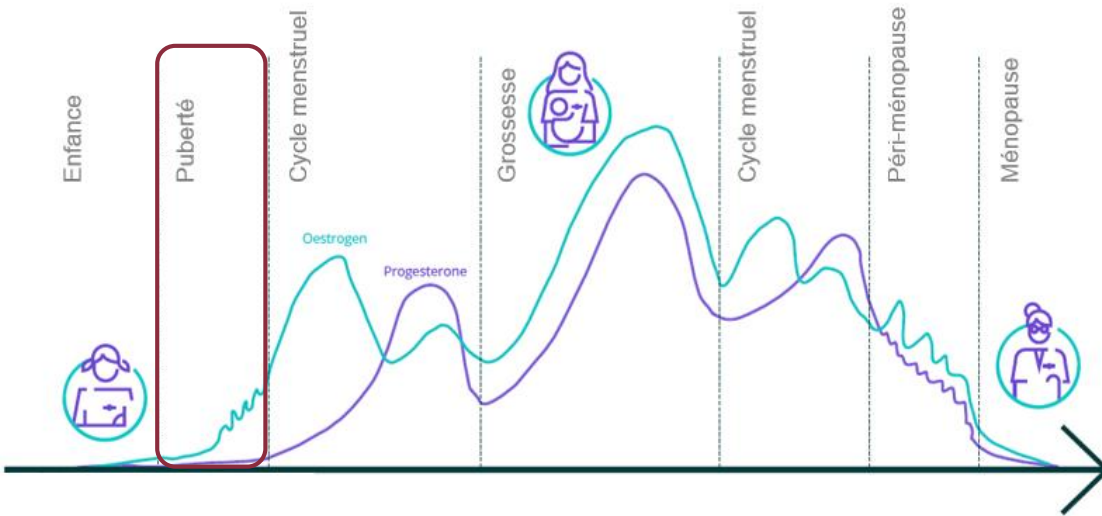


Nécessité d'une approche INDIVIDUELLE

Adolescence, grossesse & postpartum, (péri-)ménopause



Adolescence, grossesse & postpartum, (péri-)ménopause



Education – sensibilisation – communication

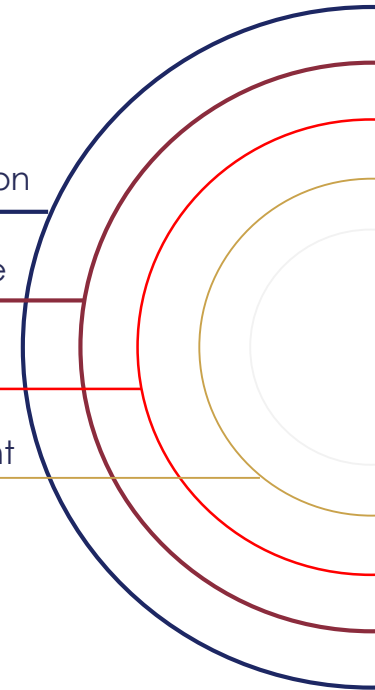
Identifier & prévenir de potentiels troubles du cycle

Mieux appréhender et gérer les effets du cycle menstruel (ex. symptômes)

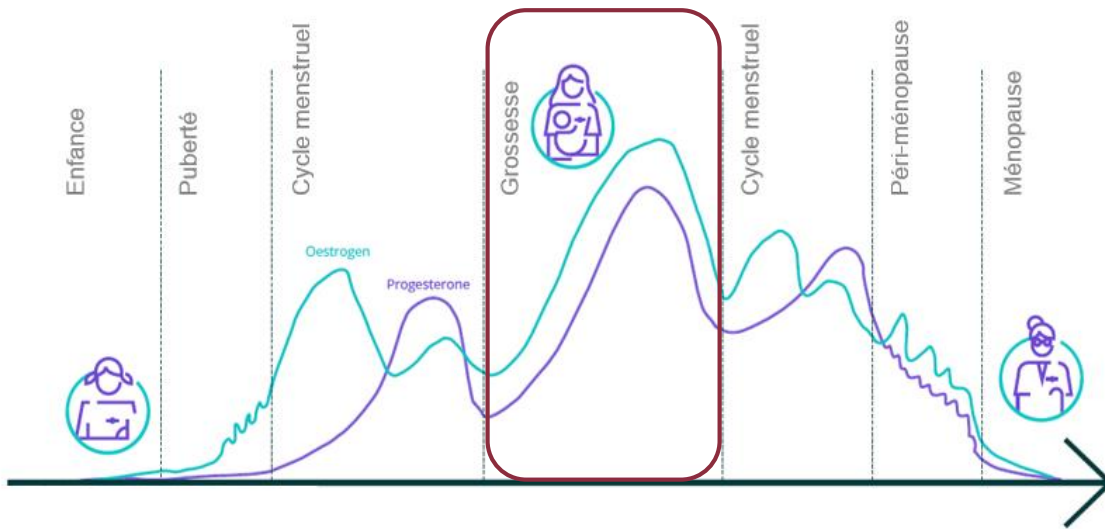
Adapter l'entrainement



Développement à long terme en tant que FEMME & SPORTIVE

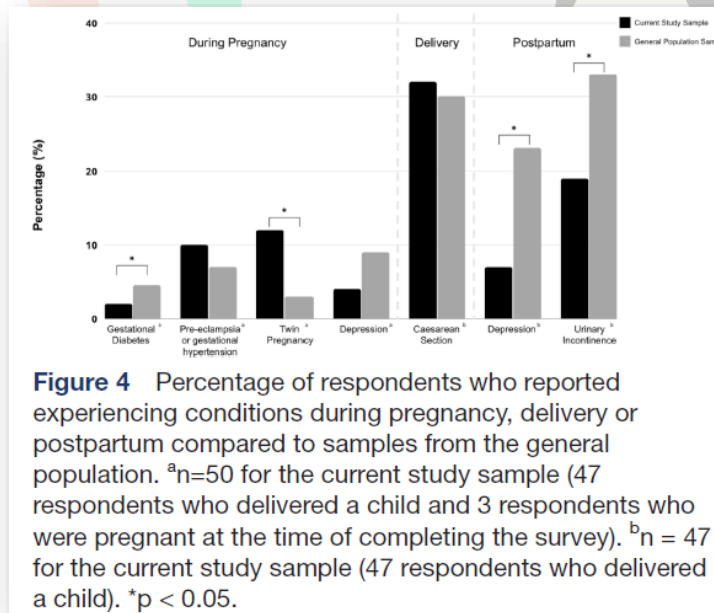
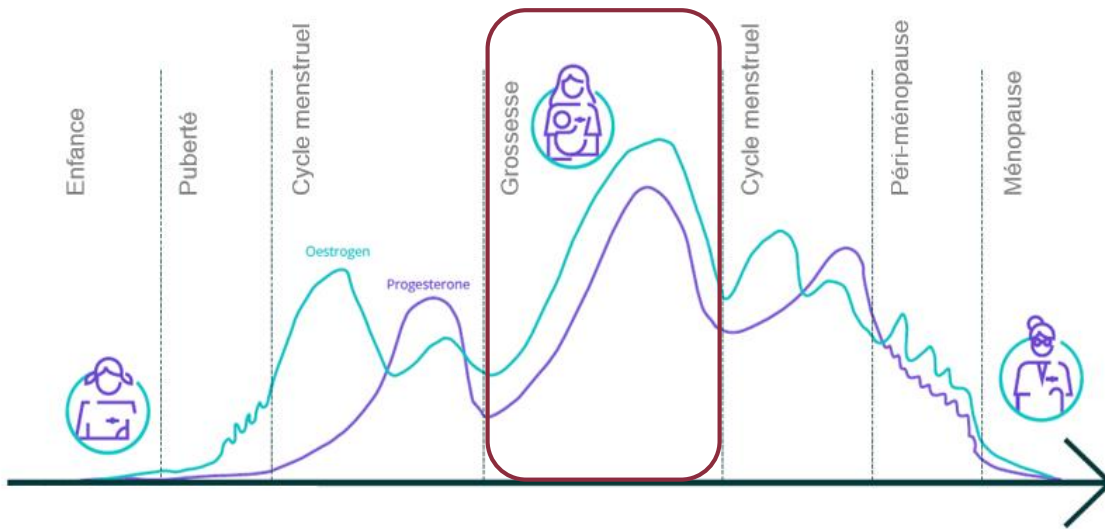


Adolescence, grossesse & postpartum, (péri-)ménopause



<https://www.sports.gouv.fr/>

Adolescence, grossesse & postpartum, (péri-)ménopause



Pas d'évidence sur l'impact de la pratique sportive (de haut-niveau) sur l'(in)fertilité, la grossesse et le post-partum, le « return to sport », ou l'âge de la ménopause

Adolescence, grossesse & postpartum, (péri-)ménopause

Santé du planché pelvien & incontinence urinaire d'effort

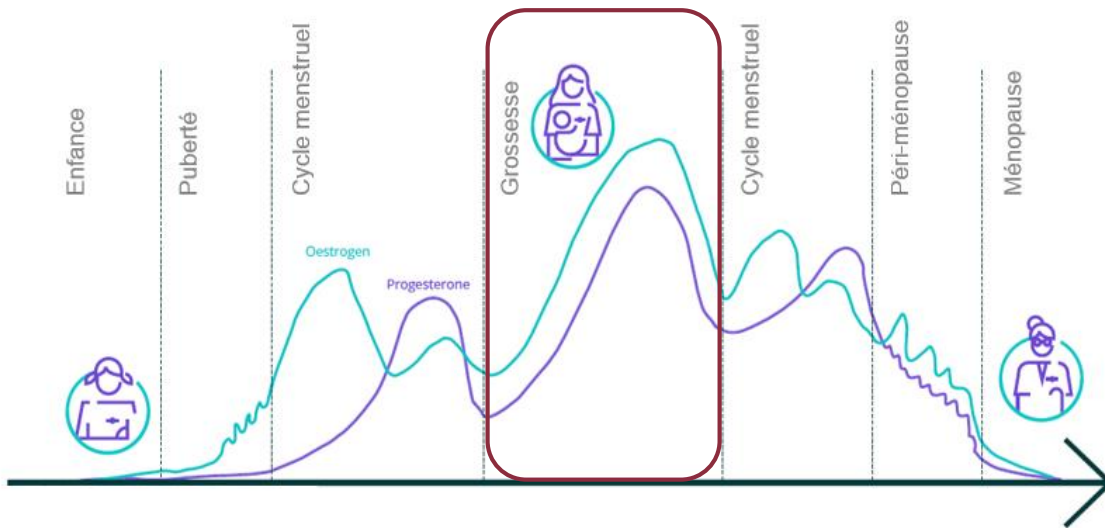


INSEP

@INSEPTV 20,7 k abonnés 663 vidéos

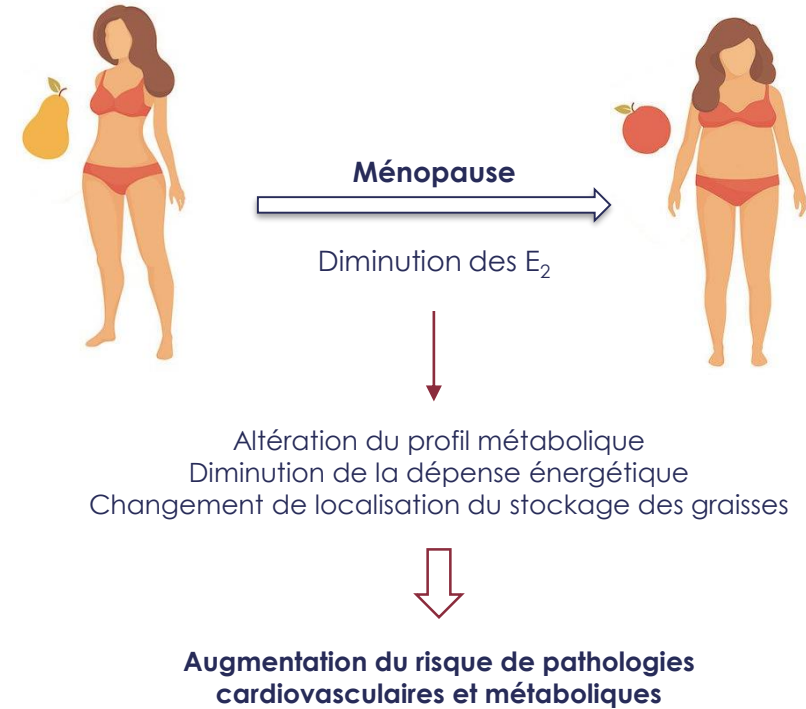
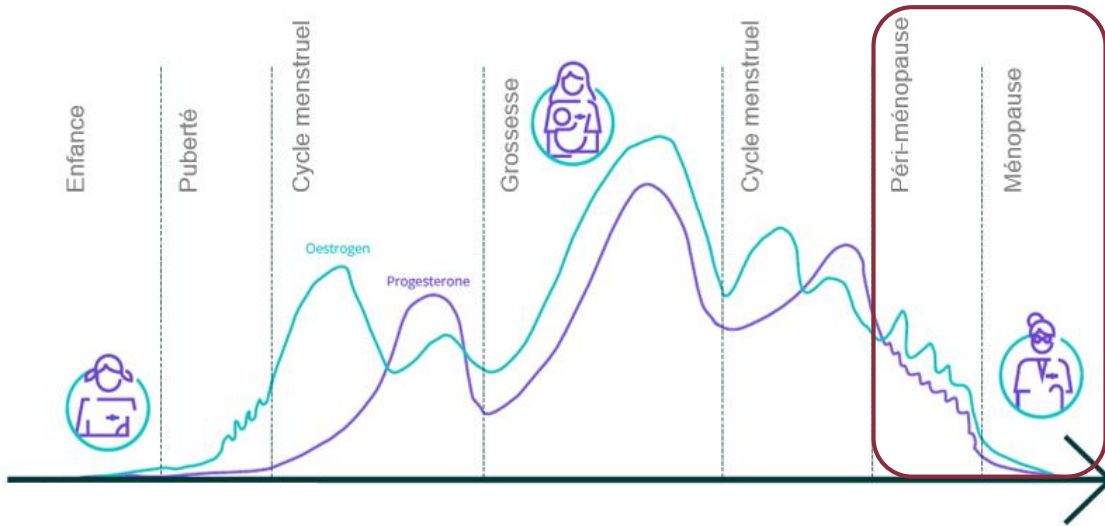
INSEP TV vous fait découvrir les coulisses de l'établissement et du Sport d... >

13 courtes vidéos explicatives (contraintes, mouvements etc.)



- 1  **Vidéo 1 : Le périnée féminin : localisation et rôle**
INSEP • 426 vues • il y a 3 semaines 1:52
- 2  **Vidéo 2 : Synergie diaphragme périnée lors de la respiration**
INSEP • 597 vues • il y a 3 semaines 2:14
- 3  **Vidéo 3 : Les contraintes de l'haltérophilie sur le périnée**
INSEP • 542 vues • il y a 3 semaines 2:58
- 4  **Vidéo 4 : Les contraintes de l'athlétisme sur le périnée**
INSEP • 160 vues • il y a 3 semaines 2:54
- 5  **Vidéo 5 : Les contraintes du judo sur le périnée**
INSEP • 118 vues • il y a 3 semaines 2:47

Adolescence, grossesse & postpartum, (péri-)ménopause





Sommaire

- 01 : Qu'est-ce qu'un cycle menstruel normal ?
- 02 : Je n'ai pas mes règles : à quoi est-ce lié ?
- 03 : Qu'est-ce que je risque à ne pas avoir mes règles ?
- 04 : Pourquoi mes règles sont-elles irrégulières ?
- 05 : Je prends du poids avant mes règles, j'ai des symptômes physiques, parfois des troubles de l'humeur avant les règles : y a-t-il une solution ?
- 06 : Suis-je moins performante lors de certaines périodes du cycle ?
- 07 : Que faire en cas de règles abondantes ?
- 08 : Que faire en cas de règles douloureuses ?
- 09 : Contraception. Est-ce que la pilule fait grossir ? Je crains d'oublier ma pilule en déplacement, en stage, y a-t-il d'autres moyens de contraception ?
- 10 : Y a-t-il toujours un examen gynécologique si je consulte un professionnel de santé pour une question de cycle, de contraception ?
- 11 : Quand dois-je consulter un professionnel de santé, spécialiste en gynécologie ?

MERCI POUR VOTRE ATTENTION

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