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SEMS EDUCATION REVIEW

Menstrual cycle and performance sports – an update

ELITE SPORTS / PERFORMANCE / RED-S / SPORTS MEDICINE / SPORTS NUTRITION

Bild: zVg

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Abstract

Top sporting performances are achieved by women and men. However, the performance of organs and metabolic processes varies due to different genetic and hormonal conditions. There is currently a considerable need for more research in this area. Sports science studies have

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mainly been carried out on male athletes and the data obtained is often not applicable to female athletes in the same way.
The following article presents the current state of knowledge on physiological differences, the menstrual cycle, contraceptive methods and energy deficit in relation to athletic performance and training. This knowledge helps to provide comprehensive care and advice to female athletes in sports medicine practice.

Zusammenfassung

Sportliche Höchstleistungen werden von Frauen und Männern erbracht. Die Leistungsfähigkeit von Organen und Stoffwechselprozessen unterscheidet sich jedoch aufgrund unterschiedlicher genetischer und hormoneller Voraussetzungen. Hier besteht derzeit noch ein erheblicher Forschungsbedarf zur Vertiefung der Kenntnisse. Sportwissenschaftliche Studien wurden überwiegend an Sportlern durchgeführt und die dabei gewonnenen Daten sind oft nicht in gleicher Weise auf Sportlerinnen übertragbar.
Im folgenden Artikel wird der aktuelle Wissensstand zu physiologischen Unterschieden, Zyklus, Verhütungsmethoden und Energiedefizit im Zusammenhang mit sportlicher Leistung und Training dargestellt. Dieses Wissen hilft in der sportmedizinischen Praxis, Athletinnen umfassend zu betreuen und zu beraten.

Schlüsselwörter: Athletin, Zyklus, Verhütung, Leistungsfähigkeit

Introduction

Women differ from men in physiology, anatomy and many other areas. When providing sports medicine care to female athletes, it is helpful to know how they differ from male athletes and what specific questions or complaints they may have. Better knowledge allows for more open communication with female athletes, which can also improve treatment and care.
There is still a lack of data on female athletes in the sports science literature compared to male athletes. Many findings cannot be readily applied to female athletes. The following article summarises current evidence that may be helpful to sports medicine practitioners. The article was previously published in a similar form in this journal in 2020 [1] and is now published in an updated form.

Gender Data Gap

A recent review [2] showed that in the top six sports medicine journals from 2017 to 2021, 70% of studies examined only males or male athletes. Just under 9% of studies looked only at female athletes or women, and 20% of studies looked at both sexes. So in many areas there is a gap in data on women compared to men. Data from studies with men cannot usually be simply extrapolated to women. However, not only in the scientific data itself, but also in sports medicine, i.e. actively coaching teams and serving as board members in sports medicine societies, female physicians are significantly less common than sports medicine physicians.

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According to a recent article [3], the percentage of women is no more than 30% in different countries, and there are significantly fewer female sports medicine physicians in board positions. In SEMS, 3 out of 11 board members are currently women, and according to information on the SEMS website, 22% of members are female physicians.

Performance differences between women and men

On average, the athletic performance of women is lower than that of men. Depending on the type of sport and the duration of the competition, the differences in top performance range from 6 to 30 per cent. The differences are greatest in short duration and power sports. Men have more muscle fibres on average, due to higher testosterone levels, and therefore have a higher maximum strength. However, contraction velocity and force per unit of contraction are the same [4]. For slightly longer efforts, men benefit from higher glycolytic capacity and oxygen transport with higher average haemoglobin. In even longer competitions, fat metabolism plays an increasing role and women perform better overall. They can provide a higher proportion of energy from fat burning at comparable relative intensities [5]. They also have proportionally more type I fibres and therefore a higher mitochondrial respiratory capacity [6]. In sports such as swimming, the difference in body composition is also likely to play a role, which is why women show a very small difference in performance, especially over longer distances. Women also have an advantage in sports that require a high degree of flexibility, as oestrogen makes ligaments and tendons more elastic.

Cycle-related hormonal fluctuations and their effects

The reason for the differences in performance is the female cycle and the hormonal fluctuations and effects associated with it. In particular, the hormones LH, FSH, testosterone, oestrogen and progesterone change over the course of the cycle. LH and FSH primarily affect ovarian function, controlling ovulation and the production of testosterone, oestrogen and progesterone. Oestrogen by itself has an anabolic, vasoprotective effect, reduces bone loss, improves muscle regeneration, activates the parasympathetic nervous system and leads to water and fat storage. Progesterone, on the other hand, has a more catabolic effect, activating the sympathetic nervous system and leading to an increase in body temperature. Testosterone and other anabolic steroid hormones also show cyclical fluctuations and have different anabolic effects depending on the target organ [7]. All hormones are always present at the same time, but with different dominance and concentration over the course of the cycle. This is particularly noticeable in competitive sports. In a study of female endurance athletes, over 75% of the athletes reported cycle-related influences on individual athletic performance [8]. A Swiss Olympic survey of top Swiss female athletes showed significant cycle-related differences in subjective performance *(Figure 1).* Statistically, in many studies, cyclic variations do not lead to measurable performance differences within the cycle. However, very intense and prolonged endurance exercise can lead to a transient increase in testosterone and DHEA-S independent of the phase of the cycle [9,10].
A woman's cycle usually lasts between 21 and 35 days. A new cycle starts on the first day of

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menstruation. Menstruation can cause mild to severe pain in the lower abdomen, often radiating to the back (dysmenorrhoea). For some athletes, this makes intensive training or any physical activity impossible. Other athletes feel very powerful in the first half of the cycle (follicular phase). It has been shown that maximum strength training in the first half of the cycle is more effective than maximum strength training in another phase of the cycle [11,12].

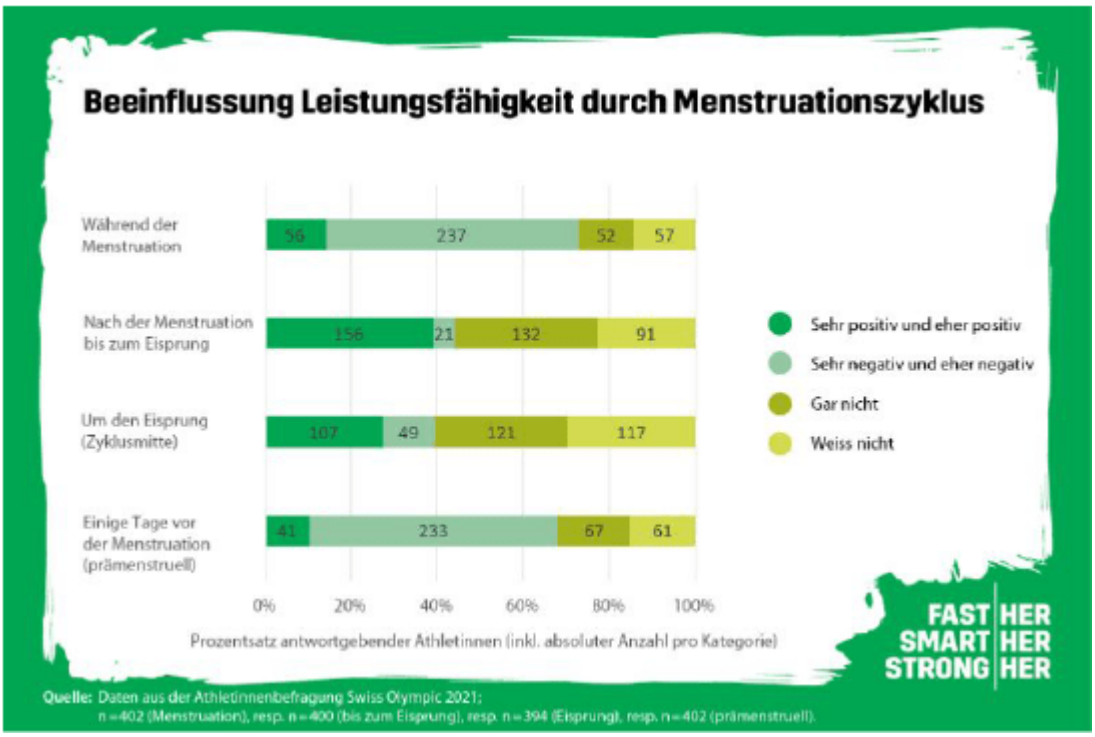

Figure 1: Cycle-dependent influence on performance in Swiss female athletes.

Ovulation occurs in the middle of the cycle, during which some women experience brief abdominal pain. Ligaments and tendons are also affected by oestrogens. Increased distensibility and laxity have been noted in the mid-cycle. This is one of the reasons why the incidence of ACL injury is up to 8 times higher in women than in men [13].
The second half of the cycle (the luteal phase) lasts about 14 days and many women find it uncomfortable, especially in the last few days before menstruation. These negative effects are known as premenstrual syndrome (PMS). There is increased water retention and a feeling of sluggishness and tension. Adaptation to a warm and humid climate may be reduced during this period [14]. Negative mood swings are common. Appetite may also be increased during this phase. Two studies showed a decrease in maximal endurance performance during the second phase of the cycle [15, 16]. Other studies found no effect on endurance performance. For strength training, stabilisation of the new training stimulus from the first half of the cycle and general recovery are recommended during this phase [17]. The different phases of the cycle and their effects are summarised in *Figure 2*.
To find out if an athlete is experiencing different effects during the cycle, it is recommended to include the cycle in the training diary or to record the possible effects with a cycle app. Often

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these effects are only noticed in the context of the cycle and can then be better integrated into training.

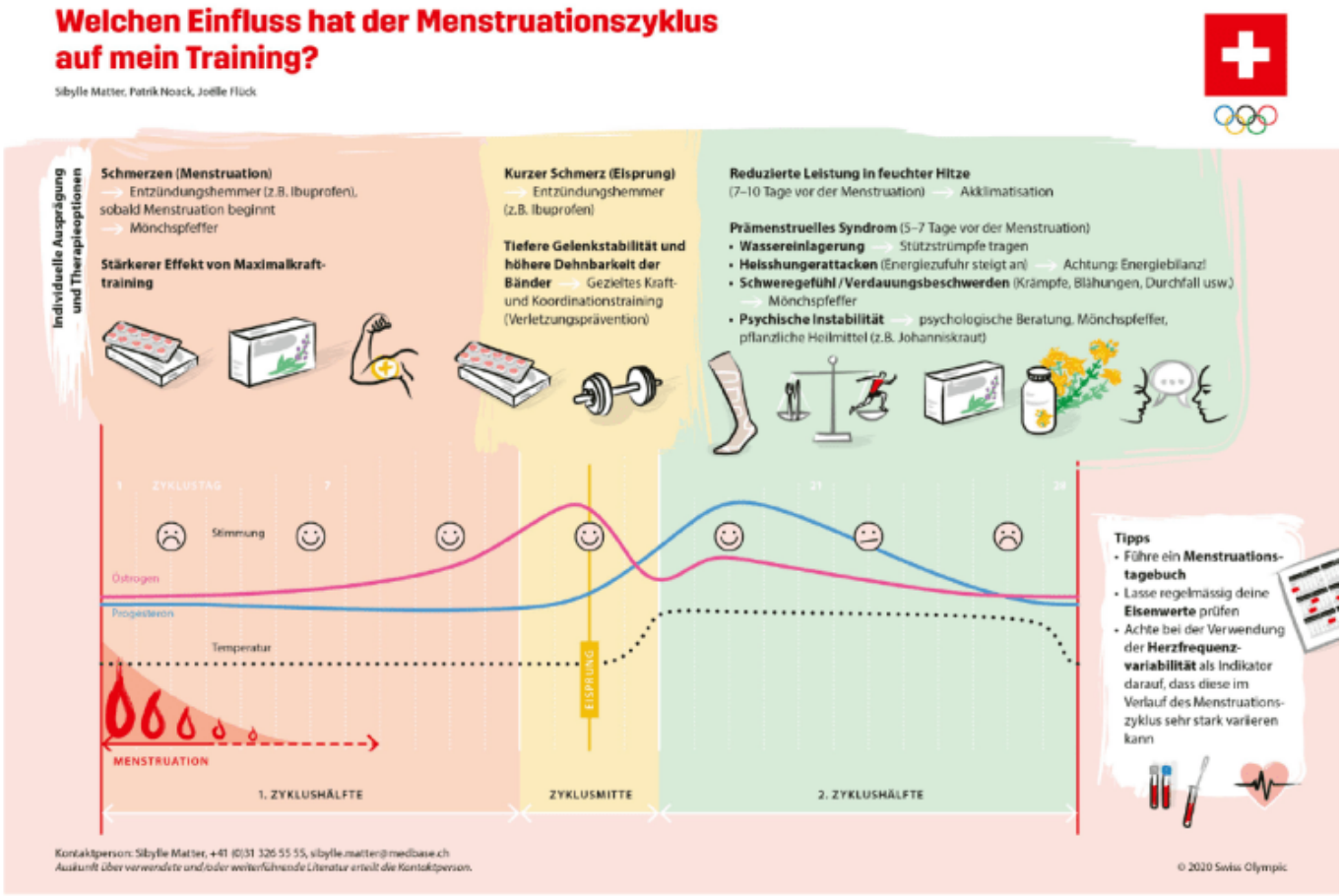

Figure 2: Infographic on the different cycle phases, effects and possible measures by Swiss Olympic. The infographic is freely accessible at http://www.swissolympic.ch.

Therapy options for cycle-related complaints

If an athlete is experiencing recurring symptoms during her cycle that are affecting her ability to train or perform, it makes sense to evaluate potential treatment options. Unfortunately, there are few non-drug options. For increased water retention, wearing compression garments is recommended. Psychological strategies may help with mood swings.
For more severe menstrual cramps, short-term therapy with magnesium or NSAIDs such as 400 mg of ibuprofen and additional local heat often helps. If the pain cannot be kept at a tolerable level with NSAIDs, or if NSAIDs are needed regularly, a gynaecological examination should be carried out to discuss alternative therapies and, if necessary, to check for the presence of endometriosis. In the case of severe hypermenorrhoea, a specialist should also be consulted so that the cause can be treated specifically (e.g. for myomas) or non-specifically (e.g. with progestins).

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For PMS or to alleviate dysmenorrhoea and mood swings, monk's pepper and/or lady's mantle extract can often make the situation more tolerable for the athlete. As herbal remedies, they are usually preferable to hormone therapy.

Influence of hormonal contraceptives on athletic performance

If the above therapies are not sufficient, or if the athlete wishes to use hormonal contraception, the question arises as to which method is most suitable for her. There are now more than 100 hormonal contraceptives registered in Switzerland, which often makes the choice difficult. Data are not available on the effects of each product formulation on athletic performance. An overview of the advantages and disadvantages of the different contraceptives is given in Table 1. When the effects of different products are measured in many female athletes, either conflicting effects or no effects on athletic performance are found [18]. However, positive hormonal effects during a regular cycle, such as cycle-controlled maximum strength training or improved muscle recovery due to the body's own oestrogen, are reduced or eliminated by the use of oral contraceptives. The incidence of ACL injuries was up to 20% lower in female athletes taking oral contraceptives [13].

Contraceptive	(Sport)-advantages	(Sport)-disadvantages	Remarks
Combined monophasic pill EE/progestin (COC	↓ PMS, ↓ dysmenorrhea, ↓ bloody strength (iron deficiency), ↓ mood swings. Possibility for cycle postponement.	↓ Effect cycle-based training such as maximum strength. ↓ Body's own oestrogen/ testosterone, ↑ appetite. Time window for taking during jet lag	Bodys own hormones such as oestrogen/progestin supressed, Increased risk of thrombosis (DVT)
Vaginal ring	Same as COC; no need to take pill daily, easier during jet lag	Same as COC	Same as COC
Patch	Like vaginal ring	Same as COC	Same as COC. Less suitable for frequent sweating/ swimming
Progestogen-containing pill	↓ Dysmenorrhea, ↓ Blood flow intensity to absence of menstruation.	Intermittent bleeding possible. ↓ Effect cycle-based training	Possible in case of increased DVT risk
Contraceptive implant (progestogen only)	Same as progestogen-containing pill	Intermittent bleeding possible. ↓ Effect cycle-based training	Possible in case of increased DVT risk
Hormone IUD (progestogen only)	↓ PMS, ↓ dysmenorrhea, ↓ bloody strength to absent menstruation (↓ iron deficiency)	Little effect on endogenous production of oestrogen/ testosterone; cycle phase unclear in absence of bleeding.	Possible in case of increased DVT risk Varying duration and amount of local hormone delivery.
Copper IUD	No effect on endogenous hormone production	↓ Blood flow intensity/ Dysmenorrhea	No influence on hormones
Condom	Protection against transmissible diseases	Lower contraceptive efficacy	No influence on hormones

Table 1: Advantages and disadvantages of different groups of contraceptives.

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Relative Energy Deficiency in Sports (RED-S)

If the length of the cycle is regularly longer than 35 days, or if menstruation is absent for more than three months, it is advisable to see a doctor. In female athletes, the cause is often a RED-S problem, i.e. a regular relative energy deficit [19]. Frequently this is associated with an eating disorder, but sometimes energy intake is inadequate without an eating disorder. Over time, the energy deficit leads to an interruption in the cyclical release of sex hormones such as LH, FSH, oestrogen and progesterone. Testosterone levels also drop, which is particularly detrimental in men with RED-S. Individually, the lack of energy and the drop in hormones lead to muscle wasting, decreased performance, increased susceptibility to injury, menstrual irregularities, psychological problems, decreased growth, atherosclerosis and decreased bone density *(Figure 2).* Most of these effects can be restored to a healthy state by normalising energy intake. However, in the case of bone density, normalisation and attainment of a normal maximum bone density is completed by the age of 25 at the latest. If this is not achieved, there is a risk of early osteoporosis and the risk of fatigue fractures during exercise increases significantly. If a fatigue fracture occurs in an athlete, RED-S should also be considered as the cause.
Reduced energy intake can also lead to symptoms similar to those of overtraining syndrome (OTS). OTS and RED-S have many common symptoms and similar diagnostic criteria. This knowledge is important for a more accurate diagnosis [20].
For therapy, which should start as early as possible, it is useful to provide the athlete with interdisciplinary care. A good collaboration between sports medicine, sports nutrition, sports psychology or sports psychiatry and the athlete's environment (coach, parents, partner) is necessary. According to the RED-SCAT Return to Play Model [21], depending on the severity of the RED-S, the affected person should not be released for competitions and training, or only with restrictions. Psychological treatment is particularly important in the case of an eating disorder. For treatment, it may be helpful for the athlete to consider the positive effects of weight gain through increased training and subsequent competition participation.
In the case of RED-S, it is definitely not recommended to simply "normalise" the cycle with a combined oral contraceptive (COC). This gives the impression that menstruation is regular again and everything is fine. However, the combined oral contraceptive pill keeps the body's own oestrogens and progestins low or suppressed, and the oestrogen in the pill leads to a (often additional) decrease in bone density after oral intake, with a possible persistent regular energy deficit [22]. If bone density is already reduced and therapy does not improve, transdermal hormone replacement therapy with oestrogens and intermittent progestogens is recommended until the situation normalises.

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Wie wirkt sich ein relativer Energiemangel (RED-S) auf Körper und Leistungsfähigkeit aus?

Sibylle Matter, Joëlle Flück

swiss olympic
spirit of sport

Beim RED-S (Abkürzung für **Relatives Energiedefizit-Syndrom** oder auch **Relatives Energiedefizit im Sport**) führt ein wiederholt vorhandenes Energiedefizit (Energieaufnahme deckt den Gesamt-Energieverbrauch nicht) zu hormonellen Störungen, die eine Leistungseinbusse im Sport, Knochendichteminderung und weitere gesundheitliche Probleme zur Folge haben können.

Bei Auftreten von einem oder mehreren der beschriebenen **Symptomen** sowie bei grösserem **Gewichtsverlust oder Essstörungen** wird eine **Konsultation beim Sportarzt/Sportärztin dringend empfohlen.**

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Figure 3: Infographic on the causes and effects of the RED-S by Swiss Olympic. The infographic is freely available at http://www.swissolympic.ch.

Conclusion of the sports medical consideration

The aim is to improve communication between doctors, coaches and other caregivers of female athletes by increasing knowledge about the sports medical care of female athletes and breaking down the taboos surrounding the menstrual cycle, menstruation and contraception. Athletes should be able to find a sympathetic ear when they have questions about their performance in relation to the cycle. Through information processing, education and training of the professionals involved, such as sports medicine and related fields female athletes can be helped more quickly and at all levels when problems such as RED-S occur. More studies looking at women from grassroots to elite level are needed to improve our knowledge of women and sport. Swiss Olympic has launched the “Women and elite sport” project to promote this and to better communicate existing knowledge to the target groups. The website http://www.swissolympic.ch/fs provides information about the project and will be continuously updated.

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Multiple-choice-Fragen
Mehrere Antworten können richtig sein.

1. *Welche Symptome gehören zu einer RED-S (Relative Energy Deficiency in Sports)?*
   a) Essstörung
   b) Verlangsamte Entwicklung
   c) Insertionstendinopathien
   d) Amenorrhoe

2. *Sehr viele Athletinnen spüren einen Einfluss des Zyklus auf ihre Leistungsfähigkeit, weil das Östrogen einen positiven Einfluss auf die muskuläre Regeneration hat.*
   Welche Aussage ist richtig und stimmt die Verknüpfung?

3. *Die folgenden Kontrazeptiva beeinflussen die weiblichen Sexualhormone (z.B. Östrogen, Progesteron):*
   a) Kupferspirale
   b) Vaginalring (z.B. Nuva Ring®)
   c) Niedrig dosierte Hormonspirale
   d) Minipille

Antworten: 1a, b, d – 2 Ja und Ja, Verknüpfung nicht korrekt – 3b, d

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CONTRACEPTION CYCLE FEMALE ATHLETE PERFORMANCE