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## Menstrual dysfunction and oral contraceptive effects on sports performance and ACL injuries.

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### Abstract

*In female sport you may experience a high incidence of menstrual dysfunction that affects from the 60% of the 79 athletes practicing competitive sports.*

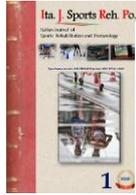
*In practice, this alteration is characterized by a significant decline of reproductive hormones and associated with a normal menstrual rhythm changed.*

*The literature suggests that the degree of disintegration of the reproductive axis in female-athlete, it can also be due to the intensity or sudden changes of your training's plan.*

*Hormone concentration's changes during the menstrual cycle may be a predisposing factor for increased articular laxity with increased risks of traumatic injuries.*

*The target of this research is to analyze how much is present in the literature about oral contraceptive use and its correlations with sport performance.*

**Key Words :** Menstrual cycle, oral contraceptive, ACL



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## Impact on performance and on risk factors related to the trauma of menstrual cycle disorders in women's football.

Soccer is becoming the main global sports for women, with 21 millions registered sport women by FIFA. Soccer is currently the top female sports in England with 131 678 9600 registered players and club.

There is a good international scientific evidence on trauma in women's soccer. These two recent works photograph clearly damaging trauma events incidence in women's soccer.

The first of E. Giza<sup>37</sup> of 2005 are highlighted 202 data relating to players 8 teams of the first two seasons of the Women's United Soccer Association (WUSA)

A total of 173 found injuries were relevated that occurred in 110 soccer players with a percentage of overall injuries incidence of damage to 1.93 1000 hours of play.

The incidence of injuries during training and races was 1.17 12.63 and for 1000 hours of play, respectively.

Of the total injuries 82% were acute and 16% were chronic. Most injuries (60%) were located in the lower limbs.

They were so distributed:

1. stretching (30.7%),
2. distortion (19.1%),
3. bruises (16.2%),
4. fractures (11.6%).

Anatomical districts most commonly affected by an injury were knee (31.8%) and head (10.9%).

Injuries to the anterior cruciate ligament is placed on a percentage equal to 4.6% of all injuries and the incidence of ACL ruptures were 0.09 for 1000 hours of play.

Knee injuries still prevail, according to authors in these elite athletes, out of all the others.

The second work is on the 2006 by O Faude<sup>38</sup> who conducted a screening on trauma on 143 female soccer players in the German National League.

The incidence of lesions was significantly higher in defenders (9.4 damage to 1000 exposure hours) and forwards (8.4/1000 hours) and goaltender (4.8/1000 hours) and midfielders (4.6/1000 hours).

Ten percent of all players (n = 14) claimed more than three lesions per season. Most of these were defenders (n = 8) or forwards (n = 4).

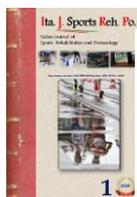
Significantly more lesions were dominant limb (105 v 71, p = 0.01); This was especially true for injuries from contact/contrast (v 29 52, p = 0.01).

Changes in hormone levels can theoretically lead to an improvement or a decrease in performance or even trauma damaging events during the different phases of the menstrual cycle.<sup>22,23,24</sup>

In adult women, the fluctuating levels of estrogen and progesterone varies throughout the menstrual cycle undergoing a permanent change of its structure, life stages, pre-and postmenopausal post.

The alteration of the values of estrogen has been implicated, as a causal factor, predictive for capsulo-ligamentous injuries of the knee in female athletes, with particular reference to anterior cruciate ligament injuries.

Recent studies on rabbit models, showed an alteration of fibroblast proliferation and collagen synthesis in the anterior cruciate ligament.



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Studies about the influence of hormonal changes during the menstrual cycle, on performance and their correlation with ligament injuries of the knee and ankle are already present in 1984 where among other things Radsievskij<sup>1,2</sup> pointed out that the performance of athletes changes according to time or stage of the menstrual cycle.

Florini<sup>3</sup> has shown that steroid hormonal fluctuations in women adversely affect the nervous system and metabolic functions.

During the ovulatory phase, Zain<sup>4</sup> occurs during athletic performance, a decrease of elaborative processes of proprioceptive information and cognitive performance.

Lebrun<sup>5,6</sup> has reported a significant decline in aerobic capacity, in the luteal phase, as subsequently confirmed and emphasized that hormonal fluctuations that occur during the menstrual cycle can affect in different percentages, aerobic metabolism and strength levels of muscle, causing, after intense exercise, a decrease in blood glucose.

However, the influence of the various phases of the menstrual cycle on training and in particular on the strength is still unclear or rather controversial.

Greeves<sup>7</sup> reported that the peak torque of the quadriceps is highest at mid-luteal phase. The alteration of the neuromuscular processes, due to hormonal fluctuations, seem to have an important role in the incidence of anterior cruciate ligament injuries with impaired proprioception.

Specifically, female athletes show a decrease of articular stiffness, with a relative destabilization or better to say instability of the knee joint.

The consequential instability of the knee, in women athletes, involves a greater deficit of neuromuscular coordination, with persistent muscle imbalances, mainly involving muscle groups of knee quadriceps and hamstrings.

The integrity of a ligament depends on the type, meeting summaries, cross-linking and collagen remodeling.<sup>29</sup>

The type I collagen give greater mechanical strength to the connective tissue. Generally, hormonal fluctuations during the menstrual cycle appear to stimulate changes in the metabolism of the fibroblasts of the anterior cruciate ligament and this could, in a negative result in a decrease in the tensile mechanical anterior cruciate ligament and preparing athletes to injury.

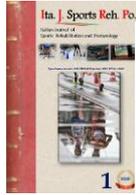
It now seems certain, from the large literature we reviewed, that the majority of ACL injuries occur during the ovulatory phase.

In three football seasons studied from three seasons studied, by J. Agel,<sup>34</sup> were 45 ACL injuries from non-contact ankle sprains and 116 of non-contact.

Anterior cruciate ligament injuries do not touch and ankle sprains occur at significantly higher rates, almost double, in basketball and in football. This percentage difference can not be related to hormonal changes. There was no difference in percentage in terms of incidence of injury among athletes who use hormone therapy and those athletes who do not use hormone therapy.<sup>34</sup>

Slatterback<sup>8</sup> pointed out in a study of 37 athletes who 26 had a torn anterior cruciate ligament during the follicular phase of the menstrual cycle linking between their menstrual histories, with hormonal profiles (determined by saliva samples within 72 hours after injury) and chronological time of anterior cruciate ligament injuries.

It is to be highlighted, however, another particular: of these lesions 26 10 occurred a few days before and two days after the menstrual cycle.



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According to the analysis of the author the hormone concentration increases during the follicular phase, reaching a peak just before ovulation, and then decreases immediately and abruptly to move up again, together with progesterone, reaching a peak wider during the luteal phase.

In a work of Wojtyś<sup>9,10</sup> were evaluated at 24 hours after injury Ica, samples of urine and blood to determine hormone levels at the time of the damaging event.

The study found that the highest percentage of injuries to the anterior cruciate ligament was placed during the day ranging from 10 to 14 of the cycle (ovulatory phase, a high concentration of estrogen).

During the years of reproductive hormone levels in women, fluctuate during the menstrual cycle with a variation of the physiological parameters and athletic performance that suffer considerable influences from the various phases of menstrual cycle.

The influence that these changes have the time trends of the processes of growth, maturation of metabolism, cardiovascular functions and the musculoskeletal system are known, rather less known correlations between trauma - injury - hormonal effect.

From recent work<sup>23,24</sup> it would seem that both estrogen and relaxin, creating profound changes, the neuro-muscular-tendon and on the apparatus my women, by changing the resistance levels that significantly elevate the index infortunabilità of female athletes.

Hence the high incidence seen especially in jumping sports injuries of Ica, from 2 to 8 times more than men<sup>23,24</sup>

Muscle imbalances of power that go beyond the 15% and the flexibility of the group extensors / knee flexors and hip extensors, were seen by Knapik<sup>11</sup>, be an additional factor of injury, anterior cruciate ligament in female athletes and this regardless of hormonal changes.

Among other things in the premenstrual and menstrual also it occurs a decrease of the index of aerobic endurance as well as strength levels and coordination skills.

The periods defined "post menstrual" and "post-ovulatory" instead, are characterized by a more relevant joint mobility, with a relative increase in the flexibility and greater proprioceptive sensibility.

Most women who play sports at various levels, primarily choose to use an oral contraceptive as a contraceptive, and this also to stabilize the cycle and to control premenstrual symptoms often are "incompatible with the sport activity."

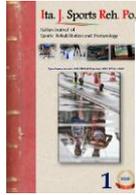
But the literature<sup>28</sup> gives addresses also precise, on the events traumatological: the use of the oral contraceptive produces statistically significant decreases, for example, in "anterior shear force" of the knee and reflection journals a key role in the decrease of laxity and lesions of the anterior cruciate ligament.

### **Influences on the performance of the oral contraceptive**

Menstrual disorders are common among athletes and the use of "the pill" is recommended as a replacement or addition of estrogen.

Few are the informations in the literature regarding the effects of oral contraceptive use in athletes, and there is great apprehension about the possibility that the "pill" damage physical performance.

The influence of the oral contraceptive does not seem clear in elevating the risk of stress fractures, as well as weight gain and the positive or negative impact on performance, the components aerobic / anaerobic and strength.



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The negatives include "hassles" as headache, "rigidity breast", fluid retention, nausea, and a possible increase in body weight.

You may encounter, according to Zain <sup>4</sup> in a very old work appeared in the Journal of Sports Medicine and Physical Fitness del 1989, the possibility of a slight risk of hypertension, with reports related to an increase in the risk of breast cancer, due to the hyper use the oral contraceptive.

However, most of the vascular complications, are reported to high, dosages in the use of oral contraceptive, mostly found in athletes smokers that have associated high risks of cardiovascular diseases.

Elliott <sup>12</sup> in a 2005 study, he tested 14 athletes who took an oral contraceptive for 6 months (seven athletes were placed in a control group).

The maximum isometric strength of the lower limb, and blood concentrations of estradiol and progesterone were measured on the 7th and 14th day after taking the "pill" at the end of dosing and again after the 5th day.

In the control group it was examined the maximal isometric strength and hormone concentrations on days 2 and 21 of the menstrual cycle.

There were no observed significant changes in the concentration of estradiol or progesterone and strength during the stages of administration of the pill.

The group "pill" did not differ significantly from the control group, despite a significant increase in the concentration of progesterone and estradiol in the 21st day of the menstrual cycle.

The analysis of the findings, suggests that the use of oral contraceptive does not affect the values of muscle strength, even these processes are stabilized, during the menstrual cycle.

Redman <sup>13</sup> states that the improvement of performance in athletes corresponds to a decrease in the concentrations of estrogen and progesterone.

The use of the oral contraceptive, provides, according to this author, to a substantial reduction of regulation and steroidi sexual, thus standardizing all types of metabolic activity.

Hewett <sup>14</sup> confirms this notion that the administration of the oral contraceptive stabilizes hormone levels during the menstrual cycle and can improve the function of the neuromuscular control of the knee joint.

Hartard states that the use of oral contraceptives (OC) is associated with a decrease in the "bone mineral density" (BMD) of the dorsal spine and femoral neck in women athletes.

The use of oral contraceptives may be an important risk factor for the "bone mineral content" in young women.

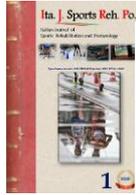
This fact is confirmed in the literature by Almstedt Shoepe H, which in a 2005 publication states that 50% of American women between 20 and 24 years use an oral contraceptive.<sup>22</sup> and that in this age group could target the development of the bone tissue <sup>22</sup> with subsequent increases in the levels of osteoporosis.

Already Daggett et al <sup>26</sup> showed a significant reduction in the VO2MAX (from 44.6 to 39.8 ml / kg / min) in a group of seven women moderately trained after one to two months of oral contraceptive use.

As well as Gretchen A. <sup>16</sup> recently reported a decrease in peak VO2 during administration of triphasic oral contraceptive.

The use of oral contraceptives increases significantly (P 0.05), body weight (59.6 ± 2.3 to 61.2 ± 2.6 kg) and fat mass (13.3 ± 1.3 to 14.5 ± 1.3 kg), a decrease of V O2.

It should be noted that a monophasic oral contraceptive, fluctuations in estrogen and progesterone levels remain constant throughout the cycle of administration.



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In contrast, with the use of a triphasic contraceptive hormonal changes of estrogen and progesterone, change with the variation of the cycle approaching those fluctuations that occur during a normal menstrual cycle.

In any case, a low dose administration for 4 months, a triphasic contraceptive from place, to a significant increase of the body weight and fat mass and a significant decline comparable to 11% - 13% of peak VO<sub>2</sub>.

For CM Lebrun,<sup>25</sup> aerobic capacity decreased in group oral contraceptive through the three phases.

Against there was, a decrease in VO<sub>2</sub>MAX between the follicular and luteal period. The average decrease in the follicular phase was 4.7% in the oral contraceptive compared with + 1.5% in the placebo group.

Besides the subjects of the group oral contraceptive increased the weight (+1 kg) and fat percentage p (+ 1%) but those in the placebo group showed no change.

There were no significant differences in aerobic endurance, anaerobic capacity, or in the isokinetic strength.

Another study Notelovitz M<sup>31</sup> carried out on 2 groups of athletes, a control group (n = 6) and an oral contraceptive group (n = 6). It showed about 6 months of administration, that the control group increased the aerobic capacity by about 8% (from 42.6 (2.8) 45.9 (5.8) the ml / kg / min), while after six months of administration monophasic VO<sub>2</sub>max suffered a decrease of approximately 7% (from 41.2 (11.8) 38.4 (9.8) the ml / kg / min).

We can therefore say that there is a clear trend towards a decrease of VO<sub>2</sub>MAX athletes in competitive sports practitioners who use oral contraceptives.

The use of oral contraceptives has been shown, when making a heavy exercise, altering the metabolic substrate, including carbohydrates and lipids and cause a drop in blood glucose.<sup>32,33</sup>

It has been postulated that the use of the oral contraceptive can prevent normal decreases force occurring during the luteal phase of a menstrual cycle.

There were no significant differences in the measurements of muscle strength with the use of oral contraceptive or placebo.

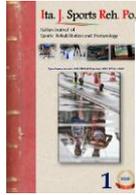
This is confirmed by a recent study carried out by KJ Elliott<sup>27</sup> and during administration of oral contraceptives, did not show significant changes in the concentration of estradiol or progesterone and the force during the various phases of the menstrual cycle.

Ricken Anette Lund et al in a project of 2004<sup>17</sup> states that the administration of the oral contraceptive, lasted 10 months, in women athletes, practitioners running, has reflected primarily on increasing the weight and fat mass. the same administration, however, could be used for the prevention of osteoporosis in women athletes with amenorrhea, because the pill has resulted in the athletes, the object of the study, an increase in bone mineral density.

It can not be excluded that an increase in body fat, has adverse effects on exercise performance.<sup>17</sup>

Many studies in the literature have shown that during the execution of exercises to moderate and high intensity, lactate concentrations tend to be lower in the luteal phase in Vs. average follicular, the menstrual cycle.<sup>18,19,21</sup>

We could highlight the allegation made by Constantini NW<sup>30</sup> in a recent project of 2005 the use of the oral contraceptive can be beneficial for female athletes who are affected negatively by their menstrual cycle, in fact it can with the contraceptive experience they can find a hormonal stability verifying an improved performance in both training and competitions.



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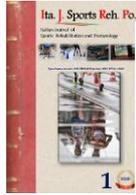
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## Conclusions

Hormonal changes can theoretically lead to different results on the performance and this also in relation to the fluctuations during the menstrual cycle.

It is possible to notice from the trauma scientific evidence an increase of injuries to the lower limb.

The use of the oral contraceptive stabilizes the cycle and hormonal changes and as such it finds positive confirmations in the literature on the incidence of injuries, in contrast, however, it is correct to point out that from the same a decrease in aerobic capacity during prolonged treatment.



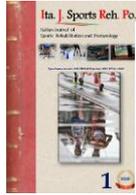
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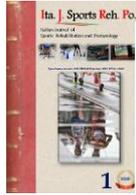


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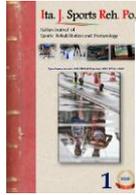


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