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Physical performance and women cardiorespiratory skills during the menstrual cycle

Judith Fifamin AHOUNOU AÏKPE[1,2*], Fleurette Magnifica KOUKPOLIYI[1], Jean-Bénoît M GODONOU[1], Lucrèce Mahoutin KOTIN[1], Paul Ogoulaye ADEKEMI[1], Emmanuel Jesugnon GBOVI[1], Barnabé AKPLOGAN[3], Joachim Djimon GBENOU[2], Pierre H. DANSOU[1]

[1]Unité de Recherches en Physiologie de l'Effort, Institut National de la Jeunesse de l'Education Physique et du Sport, Université d'Abomey Calavi, 01 BP : 169 Porto-Novo Bénin

[2]Laboratoire de Pharmacognosie et des Huiles Essentielles, Faculté des Sciences de la Santé, Faculté des Sciences et Techniques, Université d'Abomey Calavi, 01 BP 918 Cotonou, Bénin

[3]Unité de Recherche, Déficiences, activités Physiques Adaptées et Réhabilitation

*Correspondance Author: Dr Judith Fifamin AHOUNOU AÏKPE

E-mail: *judifam@yahoo.fr*

Abstract

The menstrual cycle is a series of events that take place every month during the woman's fertile years, except during pregnancy and lasts an average of 28 days. It is divided into three phases: the menstrual phase, the follicular phase and the luteal phase. Menstruation is the most visible manifestation of the menstrual cycle and is often accompanied by menstrual cram ps that may affect sporting performance This study aims to assess an impact on aerobic physical activity on the menstrual cycle in women. Thirty (30) girls were subjected to aerobic physical activity on treadmill. A functional exploration of the exercise followed by the measurement physical and cardiac parameters is carried out. The results show a modification in cardiovascular parameters according to the menstrual cycle phase and a slight decrease in physical performance in the menstrual phase of subjects. Altogether, this work demonstrates that during the menstrual cycle, women has physiological disturbances in the realization of an aerobic effort.

Keywords: Menstrual cycle - aerobic - Parameters - cardio-respiratory

Introduction

According to the WHO, physical activity is any movement produced by the skeletal muscles, responsible for an increase in energy expenditure. This energy expenditure calls on two main sectors: anaerobic and aerobic (Pradet, 2010) In physical practice, women periodically undergo physiological modification that have an impact on performance (Pierrick, 2010). The female body's response to physical exercise has specific characteristics due to the functioning of the reproductive system (Le Flanchec, 2013). The Changes in uterine mucosa membrane occur periodically between 11 and 13 years on the onset of menstruation and disappear at 45 to 50 years apart from pregnancy and some of breast-feeding (Mench, 2013). This period is called the menstrual cycle. It is a series of events that take place every month during the women's fertile years and lasts an average of 28 days, 24 to 35 days (Bloomenberg, 2006). This cycle is divided into three phases: menstrual phase, follicular phase and luteal phase. In some women, the menstrual phase is often accompanied by menstrual cramps that could affect the athlete's physical performance. The authors have shown that at six-second sprint, concentrations of catecholamines and lactates were not influenced during the menstrual phase in untrained women (Botcazou, 2006). Jaffre et al., 2006) showed that a Wingate exercise test did not influence physical performance in sporting women.

This study aims to assess the impact of menstrual cycle on the aerobic physical performance of women, and specifically to analyze the physical and cardio-respiratory parameters of women during the phases of their menstrual cycle.

1. Materials and Methods

1.1. Study population

The sampling strategy has led to explaining to all woman athletes students in the field of Physical and Sports Activities (STAPS) of the National Institute of Youth of Physical Education and Sport (INJEPS) of Benin. After giving informed, free and written consent for participation in the study, thirty (30) girls were selected on a non-random, reasoned-choice basis.

1.2. Inclusion and Exclusion Criteria

The study subjects met the following criteria:

- be a student at INJEPS and STAPS;
- be a girl aged between 17 and 25;
- have a regular menstrual cycle;
- have at least 8 hours of weekly physical practice;
- have no gynecological pathology
- give the free and informed consent in writing.

Subjects who are ill during the experimental phase, or between two menstrual phases and those who have refused to give their free an informed consent, are not included in the sample.

1.3. Methods

This is an experimental and comparative study carried out in the Research Unit in Effort Physiology (URPEF) of the National Institute of Youth of Physical Education and Sport (INJEPS). It shall include:

- Preparatory phase (Ethical considerations): subjects gave their informed, written and free consent to participate in the study;

- Experimental phase: After determining the anthropometric parameters and the level of physical sport practice, subjects performed a physical exercise test on a treadmill.

1.4. Experimental protocol

The exercise test consisted of a continuous treadmill run-up with a speed of 5.5Km.h-1 followed by an incremented endurance run of 1 $Km.h^{-1}$ every 3 minutes until exhaustion. The cardiac resting frequencies and the maximum frequency recorded at the end of exercise were increased. Respiratory functional explorations were carried out at rest and 5 min at the end of the exercise test. The average total duration of the race is at least 15 minutes. Subject performed this test in each phase of her menstrual cycle.

1.5. Statistical analysis

After the normal check, the Kruskall Wallis test is used to compare the average values between the three phases. The Man Withne Test allowed the binary comparison and the Wilcoxon Test the comparison of the mean values before and after. The level of significance is set at $p< 0.05$.

2. Results

3.1. Main characteristics of the subjects

The data in this table show that the average body mass index (BMI) is between 20 and 25 Kg/ m2. These subjects are not obese.

Table I: Main characteristics

Main Features	Topics (N = 30)
Size (m)	1.59 ± 0.04
Weight (kg)	55.5 ± 3.01
Age (Year)	22.2 ± 1.6
BMI (kg/m2)	21.99 ± 1.07

BMI = Body Mass Index N = Workforce

2.2. Physical performance

Performance measured during exercise indicated that distance traveled and time achieved by subjects were significantly low (p = 0.007192) in the menstrual phase compared to other phases. The mean heart rate in the menstrual phase after exercise was significantly higher than in the other two phases of the menstrual cycle.

Table II : Physical performance

	Phases of menstrual cycle		
Physical Performance	**MP**	**FP**	**LP**
Time (mn)	8.90 ± 0.70	9.70 ± 0.46*	9.50 ± 0.67*
Distance (Km)	1.09 ± 0.03	1.19 ± 0.09	1.15 ± 0.11
Calories	88.64 ± 2.14	95.00 ± 10.40	90.00 ± 15.03
Fc_r (bpm)	72.3 ± 0.9	70.30 ± 0.46	69.30 ± 0.46
Fc_{max} (bpm)	154.3 ± 8.1*	136.30 ± 13.57	132.50 ± 12.97

MP : menstrual phase FP : follicular phase LP : luteal phase *: Significant, Fcr : Rest heart rate; Fc max : Maximum heart rate

2.3. The respiratory parameters

During the menstrual phase, Forced vital capacity (CVF) values taken before exercise are significantly higher than those taken after (p = 0.005236). But no difference in the follicular and luteal phases. Otherwise, there is significance difference between CVF before values of the menstrual and follicular phases. Concerning subject's Maximum expiratory volume per second before and after exercise during the menstrual cycle, it appears that there is significant difference only at the level of the menstrual and luteal phases values respective (p = 0.31.10-4 and p = 0.010). In the menstrual phase, the Tifféneau ratio decreased after exercise (p = 0.1 10- 5).

Table III: Proximal respiratory variables

Proximal Respiratory variables	Phases of menstrual cycle MP	FP	LP
CVF before (L)	2.69 ± 0.52	2.75 ± 0.53	2.47 ± 0.34
CVF after (L)	2.09 ± 0.46**	2.89 ± 0.74	2.44 ± 0.48
VEMS before (L)	2.65 ± 0.33	2.53 ± 0.37	2.42 ± 0.33
VEMS after (L)	1.98 ± 0.48**	2.62 ± 0.38	2.54 ± 0.34*
Q before	86.63 ± 9.57	96.10 ± 4.06	85.19 ± 27.18
Q after	79.33 ± 9.46**	104.90 ± 4.72	109.10 ± 6.02

MP : menstrual phase FP : follicular phase LP : luteal phase *: Significant , **: Very significant, CVF bef : Forced vital capacity before exercise, VEMS bef : Maximum expiratory volume per second before exercise, Q : Tiffeneau's rpport

At the distal parameters in luteal phase, subjects mean value of DEM25 after exercice was significantly higher than before exrecise (p = 0.0160). In the menstrual phase, however, there was a slight decrease after exercise (p=0.0044). DEM50 and DEM75 showed a significant increase after exercice only in luteal phase.

Table IV : Les variables respiratoires distales

Distal parameters variables	Phases of menstrual cycle MP	FP	LP
DEM25 before (L/s)	6.05 ± 0.75	5.75 ± 1.01	6.70 ± 0.39
DEM25 after (L/s)	5.53 ± 1.20**	6.08 ± 1.18	6.06 ± 0.84*
DEM50 before (L/s)	4.64 ± 0.5	4.51 ± 0.36	4.73 ± 0.51
DEM50 after (L/s)	4.80 ± 0.41	4.50 ± 0.50	5.24 ± 0.46**
DEM75 before (L/s)	2.53 ± 0.63	2.61 ± 0.53	2.46 ± 0.36
DEM75 after (L/s)	2.53 ± 0.72	2.75 ± 0.42	3.31 ± 1.07**

MP: menstrual phase FP : follicular phase LP : luteal phase *: Significant , **: Very significant

3. Discussion

The average value of body mass index (BMI) of subjects is between 18.5 and 25. According to the classification of the WHO they are not obese. Also, the average value of their ages (22.2 ± 1.6) shows that they are young and has no apparent impact on their body size on the cardio- respiratory system.

The values for the duration and distance traveled in menstrual phase are significantly low compared to the other phases of the menstrual cycle. It can therefore be concluded that during the flow phase, the woman's organism is in a situation of physical, aesthetic and psychological discomfort, especially during aerobic physical activity (Nkenlifacck et al., 2016). Otherwise, this decrease could also be due to pain related to the destruction of the uterine lining in the absence of fertilization or menstrual cramps (Maître, 2007).

Heart rate is elevated after aerobic physical activity. This corroborates the results of a study which showed that the heart rate of athletes changes according to the physical exercise (Castagna et al, 2003).

Functional explorations were carried out before and after aerobic physical activity. The proximal respiratory variables taken after activity on menstrual phase are significantly reduced compared to other phases of the cycle. This implicate that the variation of the proximal respiratory parameters is not only a function of the phase of menstrual, but also of the type of exrecice practiced. Indeed, during the flow phase, heavy periods can lead to a decrease in hemoglobin, even iron deficiency anemia (Maître, 2007). This could therefore lower oxygen uptake and thus decrease the ventilation of these young girls during aerobic activity in the menstrual phase. The consequence therefore influence a decrease in their performance during this phase.

Othewise, the increase in Maximum expiratory volume per second and Tiffeneau's ratio after exercise in follicular and luteal phase reflects dilation of the airways, which leads to an improvement in girls' performance. The comparison of Maximum expiratory volume per second before exercice between menstrual and luteal phase shows that this ventilator parameter in menstrual phase is significantly higher than in luteal phase. However, the progesterone secreted during the second part of menstrual cycle prepares uterine lining for the possible reception of the egg (Pierrick, 2010). This progesterone promotes the development of blood vessels and endometrial glands. It participates in an increase in the amount of hemoglobin, which leads to an energy increase and increases the alertness of the subjects (Murray, 2005). The distal parameters recorded during luteal phase are significantly higher than those taken during follicular phase. It can be said that this increase is linked to a variation in the level of estrogen and progesterone in luteal phase. In this phase, the progesterone level drops sharply and the stimulation of the mucosa stops (Mtawali et al., 1998).

Conclusion

This study evaluated the menstrual cycle's influence on women aerobic performance. The results revealed a variation in the cardio-respiratory and physical parameters during the different phases of menstrual cycle.

In the menstrual phase, the mechanical and physiological disturbances of female's genital tract are a fundamental reason responsible for the drop in physical performance.

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