Effect of sexual activity on cycle ergometer stress test parameters, on plasmatic testosterone levels and on concentration capacity

A study in high-level male athletes performed in the laboratory

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Background. **The purpose of this study was to investigate the effect of sexual activity on cycle ergometer stress test parameters, on plasmatic testosterone levels and on concentration capacity in high-level male athletes.**
Methods. **Experimental design. Analysis of two days of testing accomplished in a laboratory setting, comparing a day with to a day without sexual activity (control day). Participants. Fifteen high-level male athletes, consisting of 8 team players, 5 endurance athletes and 2 weight-lifters, participated in the study. Measures. Each subject completed the following on each test day: two maximal graded stress tests on a cycle ergometer and a one-hour exercise stress test coupled to an arithmetic mental concentration test. Blood samples of testosterone were obtained and cardiac activity of each athlete was monitored with a 24-hour ECG tape recording over the two test days.**
Results. **Significantly higher differences were achieved for post-effort heart rate (HR) values at 5 minutes ($p<0.01$) and at 10 minutes ($p<0.01$) during the recovery phase of the morning stress test 2 hours after sexual activity. These differences disappeared during the recovery phase of the afternoon stress test performed approximately 10 hours after sexual intercourse took place.**
Conclusions. **Our findings show that sexual activity had no detrimental influence on the maximal workload achieved and on the athletes' mental concentration. However, the higher posteffort HR values after the maximal stress test on the morning of sexual intercourse suggest that the recovery capacity of an athlete could be affected if he had sexual intercourse approximately 2 hours before a competition event.**

KEY WORDS: High-level male athletes - Sexual activity - Athletic performance.

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Many coaches in the sports' world traditionally recommend high-level athletes to refrain from sexual activity before a competition event. The commonly held belief is that sexual abstention increases frustration and thereby promotes aggressive behaviour useful during a competition event.[1] On the other hand, anecdotal data of some athletes suggest that sexual intercourse before a competition event may have an anti-anxiety and relaxing effect.[1] Considering that sexual intercourse *per se* represents a moderate amount of energy,[2-4] the benefit of abstaining before a competition event appears difficult to explain. The very limited scientific information available on the effects of sexual activity on the mental and physical performance in high-level athletes before athletic competitions and the difficulty in defining and monitoring sexual behavior in man[3-7] may reflect the persistence of these opinions in the sports world and the considerable folklore surrounding this topic. An earlier study of 14 married former male athletes performed by Johnson[6] using hand grip dynamometer measurements showed no significant differences in strength and endu-

TABLE I.—*Study protocol: order of tests and events.*

Hour	Day without sexual activity	Day with sexual activity
05:00 p.m. on the eve	24-hour Holter monitoring	24-hour Holter monitoring
		Sexual relation
06:00 a.m.	Wake up	Serum testosterone
08:15 a.m.	Serum testosterone	Maximal stress test
08:30 a.m.	Maximal stress test	Arithmetic mental concentration test
12:30-01:30 p.m.	Arithmetic mental concentration test	Serum testosterone
04:15 p.m.	Serum testosterone	Maximal stress test
04:30 p.m.	Maximal stress test	

rance when comparing a day with coitus to a day of abstinence. Boone *et al.*[7] investigated 11 eleven male volunteers and found that sexual intercourse performed 12 hours before a maximal stress test had no effect on maximal aerobic power, oxygen pulse and double product.

The aim of this study was to investigate in a laboratory setting the effects of sexual intercourse on maximal ergometric stress test parameters, on testosterone levels and on the concentration capacity of a high-level trained male athlete. It was hypothesized that sexual activity would not significantly influence the maximal physical performance and mental concentration of a high-level trained athlete.

Materials and methods

Subjects

We studied a group of 15 male athletes (mean age 29±6 years range: 20-40 years), all of high-level training, participating to national and international competitions. The daily average per week and the hourly average per day spent in training was respectively 5.2±0.7 days and 2.8±0.8 hours. Subjects comprised 1 soccer and 7 hockey players (team players [TP] subgroup), 3 cyclists and 2 long-distance runners (endurance athletes [EA] subgroup), and 2 weight-lifters. None of the subjects were taking anabolic pharmaceutical preparations.

In order to assess potential differences of the effect of the sexual relation on the different completed tests, particularly related to the specific athletic discipline, a subgroup analysis was performed comparing all parameters between the TP (n=8) and the EA subgroups (n=5). Because the subgroup of weight-lifters was composed of only two subjects, a subgroup analysis of this subjects could not be considered.

Pre-experimental protocol

The study protocol was explained to all the subjects and their wives or usual partner during the recruting phase. Each subject then visited the laboratory before the start of the actual study and was carefully familiarized with the testing procedures.

Study protocol

The protocole of this study was established in a pragmatic way, because no references from any previous studies were available. As summarized in Table I, our study protocole was structured and subdivided into three parts, including two maximal stress tests, one early (2 hours) and a second one late (10 hours) after the sexual intercourse, and a one-hour exercise stress test coupled to an arithmetic mental concentration test. The most practical moment to insert this one-hour exercise stress test was approximately 4 hours after the first maximal and 3-4 hours before the second maximal stress test. The duration of this test was fixed to one hour, in order to have sufficient time to perform the concentration test and to have data on the athletes' subjective appreciation of the effort based on the Borg's 15-point scale.

The subjects were randomly assigned into two groups according to a cross-over design: a first group of 7 athletes with sexual intercourse on the first day and no sexual intercourse on the second and a second group of 8 athletes with sexual intercourse on the second and no sexual intercourse on the first day of the study. The study was conducted over a period of two days, each day including the same tests, done at the same hour. The two test days were separated by an interval of 48 hours. Sexual intercourse, consisting of coitus with ejaculation, performed obligatorily with the wife or usual partner, took place in the privacy of the athletes' own home, free from observers, approximately between 6:00 and 6:30 a.m.

The investigators were composed of two physician (a cardiologist and an internist) and a cardiac technician. They were unaware, when performing the tests, to what group the subjects belonged.

Instructions to the subjects

Each subject was instructed to have the same number of hours of sleep and to adhere to the same alcohol-free diet as usually required during competition times. All the subjects were asked to wake up at the same hour in the morning of both test days and to have food and beverages as usually before a competition event. The subjects were required to abstain from sexual intercourse for at least 24 hours before beginning the study.

Measurements

In all subjects a clinical history was taken and a physical examination and a resting 12-lead electrocardiogram were performed.

Holter assessment

Cardiac activity of each athlete was monitored with a 24-hour ECG tape recording (2 channel Holter DMI Analyser) over the two test days. The Holter was placed at 5:00 p.m. on the eve of each test day and was taken off at the end of the afternoon stress test. Thus sexual intercourse took place under Holter monitoring.

Maximal stress tests

All subjects performed two maximal graded stress tests on a cycle ergometer (Bosch Erg 550 Cycle Ergometer with recording on a Siemens Mingocard 4) on each test day (Table I). All the subjects were familiar with ergometric bicycle training before performing the tests. After the athletes had taken the correct position on the bicycle they were asked to perform up to their maximal physical capacity starting at 75 watts, with a pedalling frequency of 60 per minute. The workload was increased by 50 watts every two minutes. Peak exercise was reached when the athlete could no longer maintain the imposed workload, corresponding to the subject's complete physical exhaustion.

Blood pressure (BP), measured manually by the cuff method, heart rate (HR) and 12-lead electrocardiography were monitored throughout exercise and during recovery, with the patient in the sitting position. Recordings were made before exercise, at the end of each exercise stage, at peak exercise, and at 1, 3, 5 and 10 minutes during recovery.

Values of maximal workload, of absolute and relative $\dot{V}O_{2max}$, of maximal and posteffort HR and of mean BP (diastolic pressure + 1/3 of pulse pressure) were taken for statistical analysis.

Testosterone blood measurements

Blood samples of testosterone were obtained by venepuncture, approximately 15 minutes before starting the maximal stress tests. The serum testosterone levels were determined by radioimmunoassay technique (Polytest Laboratory, Zug, Switzerland).

One-hour exercise stress test and arithmetic mental concentration test

A one-hour exercise stress test was performed at a constant workload of 75 watts and under Holter monitoring alone. During this procedure the athletes' concentration capacity and their subjective perception of the effort were tested. The chosen workload of 75 watts permitted a better technical achievement and thus a better quality of the concentration test. The athletes underwent during a period of 20 minutes an arithmetic mental concentration test according to the technique of Rey.[8] The test was intitated ten minutes after starting the exercise stress test, when attaining the steady state. This test ranged into the category of problem-solving tasks[9] and consisted of series of lines containing 7 numbers arranged in disorder, each line of 7 numbers followed by 7 blank horizontal lines. Each subject was instructed to rearrange the 7 numbers of each line in ascending order by writing them on the 7 blank lines, and to draw a vertical line beside the last number written at the end of each minute, and this during a total time of 20 minutes. The mean score for each subject was the total sum of all points per minute divided by 20. The aim of this test was to assess the athletes' concentration ability. This simple test mainly focused on one variable without appealing to more complex intellectual proceedings.

Ratings of perceived exertion

Borg's 15-point rating of perceived exertion (RPE) scale (10) was used as a measure of the perceived effort during exercise. On this scale, "7" represents a rating of "very, very light" while "19" represents a perception of a "very, very hard" exercise.

TABLE II.—*Physical characteristics of the subjects participating in this study (n=15).*

Variable	Mean±SD	Range
Age (years)	29.4±6.0	20-40
Weight (kg)	81.9±5.3	75-92
Height (cm)	181.8±5.2	175-191
Body surface (m^2)	2.02±0.09	1.92-2.18

Data analysis

Comparisons were made between all data obtained during the day with and the day without sexual activity in all subjects and in the TP and the EA subgroups. Multiple and repeated measures analysis of variance, as well as paired "t"-tests, when appropriate, were used to compare continuous variables of the day without and the day with sexual activity. Differences were considered significant at a p value <0.05. Results are expressed as mean±standard deviation (±SD).

Results

Subjects and sexual intercourse

Subject characteristics are given in Table II. All subjects completed the tests according to the protocole. Seven athletes had sexual intercourse on the first day and eight athletes on the second day of the study. Duration of sexual intercourse ranged from 15 to 30 minutes. The average number of hours of sleep was 7.4±0.7 hours on the day with sexual intercourse and 7.5±0.8 hours on the day without (p>0.05). There were no significant differences between both test days on the Holter recordings. The maximal HR values recorded corresponded to the maximal heart rates attained during the stress tests: 180±8 *vs* 179±12 min^{-1} (p>0.05), respectively for the day with and the day without sexual activity. Mean maximal HR values during the sexual intercourse were 113±13 min^{-1}, ranging from 88-130 min^{-1}.

Data obtained during the maximal stress test (Figs. 1A-F)

No significant differences were observed for values of maximal workload, $\dot{V}O_{2max}$, serum testosterone, and maximal HR and BP. A tendency towards slightly higher values, ranging between 2.2% and 8%, was noted in all parameters during the day with sexual activity. Multivariate analysis of variance showed significant differences for HR values during the recovery period of the maximal stress test performed 2 hours after sexual activity took place (Fig. 1E). These HR values increased by 8% at 5 minutes and at 10 minutes (F=2.9, p<0.01).

Subgroup analysis for data of the maximal stress tests in TP and EA (Figs. 2A-E)

While a tendency towards a slight increase of maximal workload (6%), $\dot{V}O_{2max}$ (7%) and serum testosterone (11%) was observed in the TP subgroup, these values tended to be slightly lower in the EA subgroup, decreasing respectively by 2.5%, 4% and 7.2% during the day with sexual activity when compared to the day without sexual activity (Figs. 2A-C). However, no significant differences were achieved. In both subgroups values of HR (Figs. 2D and E) and BP tended to increase by a 2% to 8% during the morning stress tests 2 hours after the sexual intercourse took place, however without achieving significance. In the EA subgroup during the afternoon of the day with sexual relation HR and BP values tended to decrease by a 2 % to 13%, attaining significant differences, however, only for posteffort HR values (Fig. 2E) at 3 (t=5.4, p<0.01), at 5 (t=2.9, p<0.05) and at 10 minutes (t=7.0, p<0.01).

One-hour exercise stress test and arithmetic mental concentration test

The mean maximal HR achieved during the one-hour exercise stress test was respectively 123±25 min^{-1} for the day without and 124±26 min^{-1} for the day with sexual activity (p>0.05). The concentration score values attained were 48±15 and 47±12 points (p>0.05), respectively for the day without and with sexual activity. Values in the TP group were 50±10 and 47±10 (p>0.05) and in the EA subgroup 48±23 and 49±15 (p>0.05) points, respectively for the day without and the day with sexual activity.

RPE data

The intensity of the effort was perceived as being slightly more difficult during the day with sexual activty (RPE=11.7±0.5) as compared to the day without sexual activity (RPE=12.1±1.1). This slight difference did approach significance (t=-1.9, p= 0.08). This was

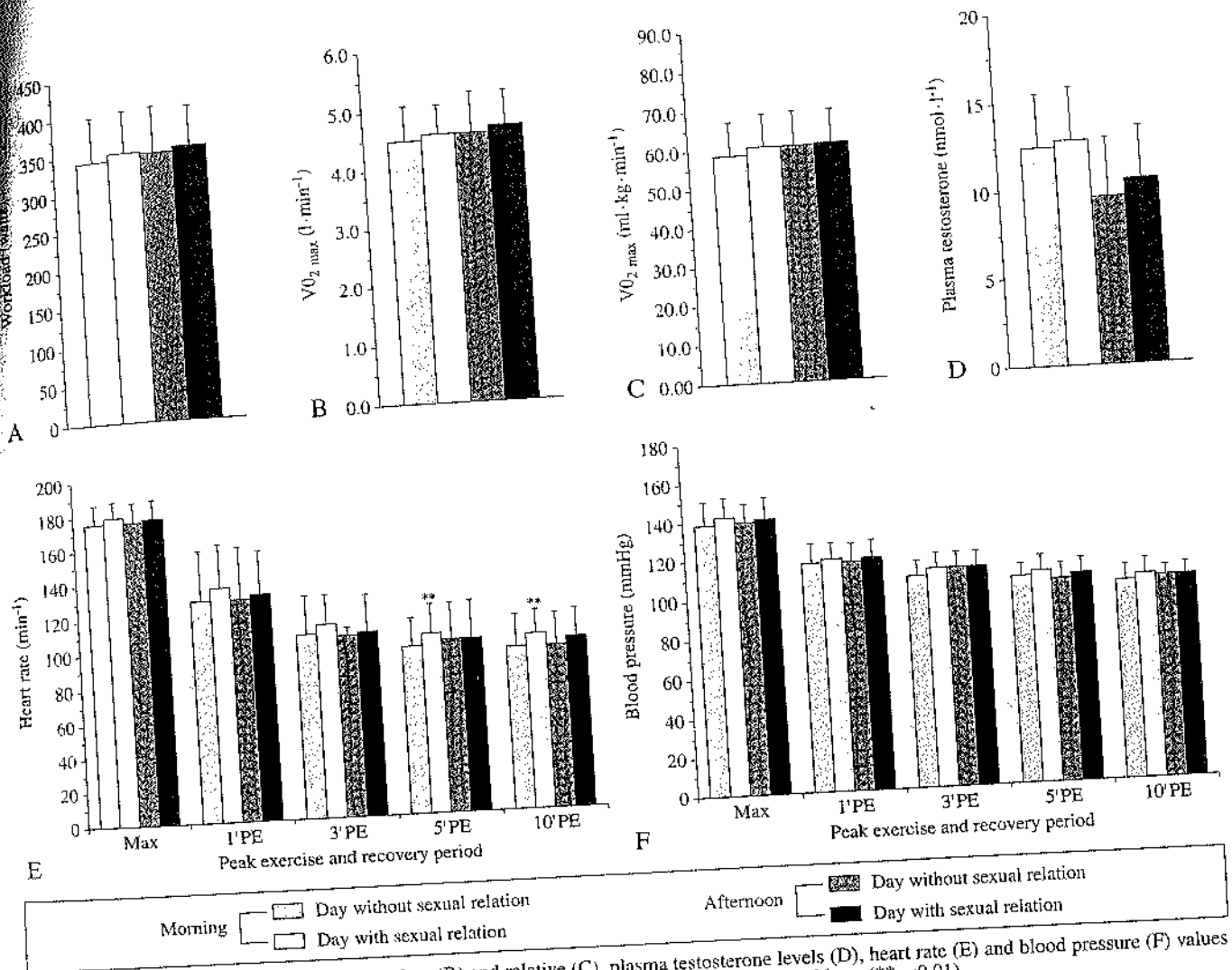

Fig. 1.—Maximal workload (A), VO_{2max} absolute (B) and relative (C), plasma testosterone levels (D), heart rate (E) and blood pressure (F) values during the morning and afternoon stress tests of the day without and with sexual activity in all athletes (**p<0.01).

mainly due to the fact that two hockey players and one soccer player appreciated the one-hour exercise stress test as being more difficult during the day with sexual activity.

Discussion

Our results showed that sexual activity had no significant effect on the maximal workload achieved and on mental concentration during the stress tests of the day with sexual activity A slight tendency, however not significant, towards a higher maximal workload, corresponding to higher $\dot{V}O_{2max}$, to higher maximal and posteffort HR and BP and to higher plasmatic testosterone values, was observed on the day with sexual activity. The most marked differences were seen in the higher values of HR during the late recovery phase 2 hours after the sexual activity took place, attaining significant differences at 5 minutes and at 10 minutes (Fig. 1E). These differences were absent during the afternoon stress test performed approximately 10 hours after sexual intercourse (Fig. 1E). A subgroup analysis comparing all parameters between the TP (n=8) and

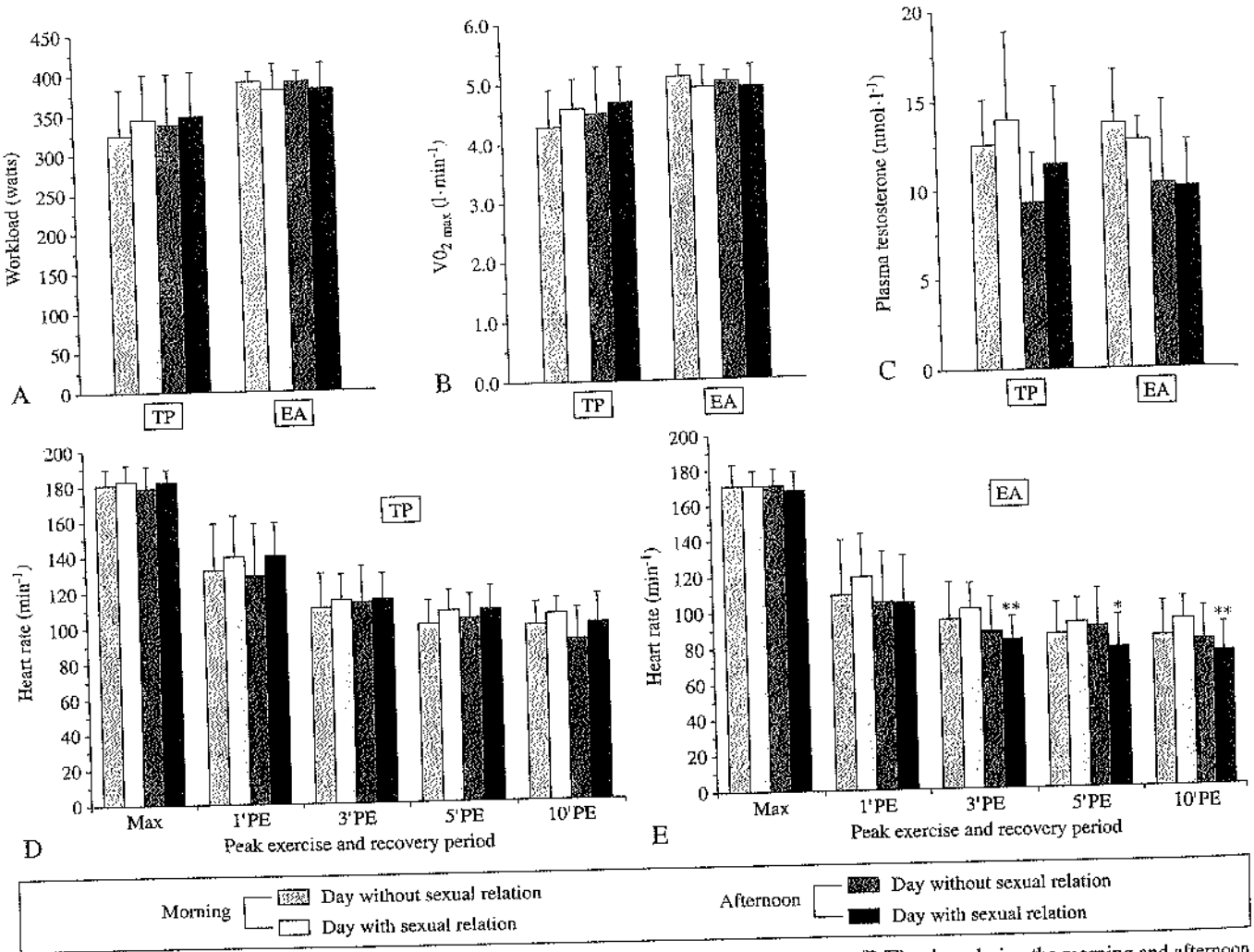

Fig. 2.—Maximal workload (A), absolute VO_{2max} (B), plasma testosterone (C) levels and heart rate (D/E) values during the morning and afternoon stress tests of the day without and with sexual activity in team players (TP) and endurance athletes (EA), (*p<0.05, **p<0.01).

the EA subgroups (n=5) revealed no significant differences for maximal physical performance. VO_{2max} and plasmatic testosterone values on both test days (Figs. 2A-C). While in both subgroups values of HR and BP tended to increase during the morning stress tests 2 hours after the sexual relation took place, however without achieving significance, values in the EA subgroup tended to be lower during the afternoon stress tests of the day with sexual activity, achieving significant differences only for HR values during the post-effort at 3, 5 and 10 minutes (Figs. 2D-E).

In our study we observed a combined influence of sexual activity on the autonomic nervous system, including increased sympathetic and decreased parasympathetic stimulation.[11 12] Increased sympathetic stimulation influencing HR and BP was seen in all athletes mainly 2 hours after sexual activity took place. The significantly higher postexercise HR values observed during the late recovery phase, which has been shown to be under parasympathetic control,[12] suggest decreased parasympathetic activation as a consequence of the sexual intercourse and indicate that the recovery capacity may be affected. In the subgroup of EA, however, HR tended to decrease particularly during the recovery phase of the afternoon stress test of the day with sexual activity (Fig. 2E), indicating

that these athletes probably have higher vagal activity,[13] and thus compensate by a decrease in HR. Finally, increased sympathetic activity was probably also responsible for increased testosterone secretion as observed in the tendency towards higher testosterone values on the day with sexual activity.[14]

As supported by the RPE data showing trends of borderline significance (p=0.08), the intensity of the effort was perceived as being slightly more difficult during the day with sexual activity, mainly due to the fact that three TP appreciated the one-hour exercise stress test as being more difficult during the day with sexual activity. This subjective perception did not significantly affect their maximal physical performance (Fig. 2A). The concentration score obtained in this subgroup tended to be slightly lower on the day with as compared to the day without sexual activity (47±10 *vs* 50±10), however without achieving any significance.

Conclusions

Our findings show that the sexual activity did not negatively influence the maximal workload achieved and the athletes' mental concentration. However, the higher posteffort HR values observed after the maximal stress test on the morning of sexual intercourse suggest that the recovery capacity of an athlete could be affected if he had sexual intercourse approximately two hours before a competition event. These higher post-effort HR values were not observed during the afternoon test, that is approximately 10 hours after the sexual intercourse took place. Although our study was performed in a laboratory setting with a small and heterogenous group of athletes, the present data may at least partially contribute to clarify the very limited scientific knowledge existing in this poorly studied area.

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