

## BASIC SCIENCE

# Sexual Activity the Night Before Exercise Does Not Affect Various Measures of Physical Exercise Performance



Gerald S. Zavorsky, PhD,<sup>1</sup> Eleftherios Vouyoukas, MD,<sup>2</sup> and James G. Pfaus, PhD<sup>3</sup>

## ABSTRACT

**Introduction:** The idea that sexual activity can affect athletic performance has been a matter of conjecture for the past several decades.

**Aim:** To provide preliminary data on whether sexual activity the evening before several physical exercise performance tests affects performance the next day.

**Methods:** Eight participants (mean age,  $28 \pm 5$  years) underwent several physical exercise performance tests on 3 different mornings, under 3 conditions: (i) no sexual intercourse the night before the tests (control), (ii) sexual intercourse the night before the tests, and (iii) yoga the night before the tests (randomized, single-blinded).

**Main Outcome Measures:** Physical work capacity, lower body muscular power (standing vertical jump), upper body strength (handgrip strength), reaction time, and upper body musculoskeletal endurance (number of push-ups completed).

**Results:** All participants experienced orgasm through intercourse. The more pleasurable the orgasm, the lower the systolic blood pressure (SBP) on the day after intercourse (Spearman's  $\rho = -0.86$ ;  $P = .007$ ). For every 2% increase in the total orgasm score, SBP decreased by 1 mmHg. Intercourse lasted 13 minutes; mean heart rate (HR) and caloric expenditure ranged from 88 to 145 beats/minute and from 53 to 190 kcal, respectively. There were no significant differences in the physical working capacity that elicited an HR of 170 beats/minute, number of push-ups completed, vertical jump height, grip strength, or reaction time across the 3 conditions.

**Conclusion:** Orgasm through sexual activity on the night before physical exercise may reduce SBP; however, we were unable to demonstrate a statistically significant difference in physical exercise performance in any of the 3 conditions. **Zavorsky GS, Vouyoukas E, Pfaus JG. Sexual Activity the Night Before Exercise Does Not Affect Various Measures of Physical Exercise Performance. Sex Med 2019;7:235–240.**

Copyright © 2019, The Authors. Published by Elsevier Inc. on behalf of the International Society for Sexual Medicine. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Key Words:** Athletic performance; Sexual intercourse; Aerobic capacity; Exercise testing; Blood pressure; Coitus

## INTRODUCTION

Superstitious behaviors, which come in a wide variety of shapes and sizes,<sup>1</sup> are common among athletes and have been a part of the

sports world since the beginning of ancient times. Many athletes in various sports disciplines participate in superstitious rituals,<sup>1–3</sup> as they believe it to be influential in controlling luck or other external factors.<sup>2</sup> One such ritual is the abstinence of sex before competition. Boxers have been known to abstain from sex, or else they'll come out for the fight "weak as a cat" says fight manager Suey Welch from a long time ago.<sup>4</sup> Athletes believe that abstaining from sex conserves strength and increase energy levels.<sup>5</sup> Another reason for sexual abstinence before the competition is to prepare the athlete to get the "right mental attitude," develop a "game face" and to develop a greater sense of unity and purpose.<sup>4</sup> While some collegiate coaches do believe that sexual activity the night before competition harms athletic performance, most coaches are not sure of its effects.<sup>6</sup> Sexual activity could also lead to improved athletic performance as there may be enhanced relaxation, lowered tension, and enhanced sleep after sex.<sup>4</sup>

Received October 5, 2018. Accepted December 16, 2018.

<sup>1</sup>Department of Respiratory Therapy, Georgia State University, Atlanta, GA, USA;

<sup>2</sup>Department of Pathology, St. John Hospital and Medical Center, Detroit, MI, USA;

<sup>3</sup>Centro de Investigaciones Cerebrales (Brain Research Center), Universidad Veracruzana Av. Luis Castelazo Ayala, sin número, Colonia Industrial Las Animas, Xalapa, VER, México

Copyright © 2019, The Authors. Published by Elsevier Inc. on behalf of the International Society for Sexual Medicine. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.esxm.2018.12.002>

There are numerous reports examining whether sexual activity affects athletic performance,<sup>7–10</sup> but these studies do not provide actual data, just conjecture. Surprisingly, there are very few reports in the peer-reviewed literature examining the influence of sexual activity on physical exercise performance. The first report, which appeared in 1968, was only approximately 1 page long.<sup>11</sup> In that study, Johnson used a hand grip dynamometer to assess the strength and endurance of the palmar flexing muscles of the morning following coitus. There was no difference compared with the abstinence condition. Approximately 30 years later, 2 more studies appeared in the peer-reviewed literature. Compared with the abstinence condition, sexual intercourse did not affect measures of cardiorespiratory exercise performance or mental acuity.<sup>12,13</sup> Another study was published in a very obscure online electronic journal (which ceased publication in 2015) that reported no significant association between marathon running performance and the number of sexual events participated in 48 hours before running a marathon.<sup>14</sup> No information on marathon times was provided. Most recently, 2 more studies were published. The first, from June 2018, examined lower extremity muscle force on the morning after sexual activity in 12 young men and found no statistically significant differences in peak or mean knee extension or flexion torque between the abstinence condition and the condition in which sexual activity occurred 12 hours earlier.<sup>15</sup> Later in 2018, another study became available online that examined several parameters of physical exercise performance—strength, balance, agility, reaction time, anaerobic power, and maximal oxygen uptake—in 10 young men.<sup>16</sup> There were no significant differences in any of the physical exercise performance tests between the abstinence condition and the condition in which sexual activity occurred the night before.<sup>16</sup>

Given the dearth of research on the effects of sexual activity on various measures of physical exercise performance, the present study aimed to provide preliminary data on the effect of sexual activity on various measures of physical exercise performance: cardiorespiratory exercise capacity, musculoskeletal endurance, musculoskeletal strength, and reaction time. The preliminary data would allow for estimation of future sample sizes for similar studies. We hypothesized that there would be a failure to demonstrate that sexual activity (ie, sexual intercourse) performed the night before a battery of physical performance tests would affect parameters of cardiorespiratory exercise performance, musculoskeletal endurance or strength, or reaction time compared with a control (abstinence) condition.

## METHODS

In the present study, we used a repeated-measures design in which the same participants were used for all interventions, including the control condition. This design mimics a crossover, counterbalanced study. Because all 3 treatments are evaluated for the same individual, the treatment effect can be estimated based on an average of within-individual differences. Given this property, a crossover trial can theoretically achieve the same precision as a parallel group trial with only one-half the sample

size. The required sample size is further reduced because outcomes measured in the same individual generally have a smaller variance than outcomes measured between individuals.<sup>17</sup> It was necessary to design the study this way, because recruiting participants would be difficult owing to the nature of the study.

Research participants were evaluated on 3 separate occasions after having met 1 of 3 conditions on the previous night: (i) control condition (abstinent and physically inactive); (ii) sexually active; and (iii) abstinent but physically active, with participants completing a 15-minute yoga exercise session intended to mimic the energetic cost of sexual activity. In men, sexual activity has a reported energy expenditure of approximately 1.7–3.3 metabolic equivalent tasks (METs), depending on the sexual position assumed.<sup>18</sup> A 15-minute yoga workout was used to mimic the energy expenditure of sex (approximately 2 METs).<sup>19</sup> The order of the last 2 conditions was randomized. This study was approved by the university's Institutional Review Board. All participants signed an informed consent form.

## Sexual Activity

Heterosexual participants participated in sexual intercourse in a private, unmonitored setting. The participants were instructed to follow their usual sexual habits. Controls on sexual activity were not imposed to maintain the validity of what is supposed to be a natural activity. There was at least a 1-week “washout” period between each session.

During sex, each participant wore a heart rate (HR) monitor (RS-200; Polar Electro Oy, Finland) that recorded the duration of sexual activity, as well as the mean and peak HR. The HR monitor could estimate total caloric expenditure as well.

An orgasm rating questionnaire was used by the participants to provide a participative evaluation of orgasm intensity.<sup>20</sup> Participants were asked to complete the questionnaire on the morning after the night of sexual activity. The ratings from this questionnaire provided scores for sensory (6 components) and cognitive-affective (4 components) dimensions of orgasm and had high reliability (Cronbach's  $\alpha \geq 0.88$  across the 3 groups).<sup>20</sup> There were 27 adjectives described on a 6-point scale (from 0 = does not describe it at all to 5 = describes it perfectly). Thus, the total summed score could range from 0 to 135 ( $5 \times 27$ ). [Supplementary Table 1](#) provides the questionnaire used for the orgasm scale for easier comprehension.

## Blood Pressure

Ambulatory systolic blood pressure (SBP) was measured with an automatic blood pressure monitor (BP710; Omron Healthcare, Bannockburn, IL, USA). Participants were asked to remain quiet and maintain the arm at rest during the measurement. The average of 2 SBP readings was recorded.

## Physical Exercise Performance Tests

### Physical Work Capacity at 170 Beats/Minute

The physical work capacity at 170 beats/minute ( $PWC_{170}$ ) is a submaximal test estimating the power output that elicits an HR

of 170 beats/minute. This assumes that the workload and HR are linear. The  $PWC_{170}$  is moderately associated with cardiorespiratory exercise capacity.<sup>21</sup> The participant warmed up for 10 minutes on a cycle ergometer (894 E Anaerobic Cycle Ergometer; Monark Exercise, Vansbro, Sweden) at a self-selected easy workload, then pedaled for 6 minutes at a power output that elicited an HR of 120–140 beats/minute. HR was averaged over the 6 minutes. Then, following a 10-minute rest, the participant pedaled at a workload that elicited an HR of 150–170 beats/minute. The average HR over the 6 minutes was averaged. Then the  $PWC_{170}$  was calculated as

$$\begin{aligned} &(((P_1 \cdot H_2) - (P_2 \cdot H_1) \div (H_2 - H_1)) \\ &+ (170 \cdot ((P_1 - P_2) \div (H_1 - H_2))), \end{aligned}$$

where  $H_1$  is the average HR over the first 6 minutes,  $P_1$  is average power output over the first 6 minutes,  $H_2$  is the average HR over the second 6 minutes, and  $P_2$  is the average power output over the second 6 minutes.

### Standing Vertical Jump and Reach Test

The standing vertical jump reach test assesses leg power.<sup>22</sup> The participant had the right fingertips stuck with Velcro. Then, while standing with a wall on the right side, the participant marked the wall with Velcro while keeping the left arm down and the feet flat on the floor. This marked the 0 cm height point. Then the participant assumed a bent knee preparatory position, paused, and then jumped as high as possible, touching the wall again with a Velcro piece. The vertical distance was measured using a digital tape measure. Each participant practiced 2 or 3 submaximal jumps, followed by 3 maximal jumps. The best vertical jump of the 3 trials was recorded as the vertical jump height.<sup>22</sup>

### Hand Grip Dynamometry

The strength of the palmar flexing muscles (hand-grip strength) was measured using a Baseline 12-0291 Pneumatic Squeeze Bulb Dynamometer (Fabrication Enterprises, White Plains, NY, USA). Hand-grip strength serves as a proxy for upper extremity strength<sup>23</sup> and overall frailty,<sup>24</sup> and the test has good repeatability.<sup>25</sup> The participant was instructed to hold the squeeze bulb at the already delineated equator of the bulb, in such a way that the line was positioned along the center of the middle finger. Three practice trials were performed with the dominant hand, followed by 3 maximal trials. The trial that provided the highest pressure (in psi) was recorded.

### Reaction Time

A ruler drop was used to assess reaction time. A 60-cm-long ruler, marked in 1-mm increments, was held between the outstretched finger and thumb of the participant's dominant hand and left to drop. When the participant was ready, the researcher dropped the ruler at random intervals (usually between 1 and 5

seconds), to prevent the participant from anticipating the time of release. From the point at which the participant catches the ruler, the reaction time can be deduced. The reaction time is the square root of  $2 \cdot d \div a$ , where  $d$  is the distance from the edge where the ruler is caught and  $a$  is the acceleration due to gravity,  $9.81 \text{ m/s}^2$ . Because there are small improvements in reaction time between the first and second testing day owing to practice effects,<sup>26</sup> the order of the sexually active and abstinent but physically active sessions was randomized.

### Push-Up Test

The number of push-ups performed without rest is used to evaluate upper body skeletal muscular endurance.<sup>27</sup> The participant was asked to start in the “down” position. The participant's hands were pointing forward and under the shoulder, with the back straight and head up, using the toes as the pivotal point. The participant then raised his or her body by straightening the elbows and then returned to the down position until the chin touched the mat. The participant was asked to not let his or her stomach touch the mat. The maximal number of push-ups performed consecutively without rest was recorded as the score.

Several measures were adopted to preserve internal consistency and to prevent a practice effect for all physical exercise performance tests: randomizing the order of the sexually active and abstinent but physically active sessions, withholding results until after the study to prevent the participant from trying to surpass his or her results on the previous sessions(s), and performing the physical exercise performance tests and hormonal and glucose sampling at the same time of day to avoid circadian-related changes in stress and exercise-related hormonal changes.

### Statistical Analyses

A linear mixed-effects model using restricted maximal likelihood estimation was used to determine whether there were any differences among the 3 conditions—control (abstinence), sexual activity, and yoga—for each physical performance test, as well as the number of hours of sleep in each condition. A separate linear mixed-effects model was developed for each dependent variable:  $PWC_{170}$ , standing vertical jump, handgrip strength, reaction time, number of pushups completed, and number of hours of sleep. For each model, the participant served as the random effect, and the 3 conditions served as categorical fixed effects. An autoregressive moving average model was used for the repeated covariance structure for the 3 conditions. If a significant main effect was detected, Bonferroni-adjusted pairwise comparisons were examined. For any missing data for a given variable, it was either imputed by taking the mean of the observed values for that variable or interpolated from other observations from the same individual.

Spearman's rho correlation was used to correlate SBP with total orgasm score. Linear regression was used to examine the unit change in total orgasm score per 1-mmHg change in SBP.

**Table 1.** Results of the physical exercise performance tests

Fitness tests	Control condition (abstinence)	Sexual activity the night before	Yoga exercise the night before	P value
PWC <sub>170</sub> , W	111 ± 31 (55–155)	109 ± 32 (55–161)	106 ± 32 (54–163)	.27
Standing vertical jump height, cm	44.9 ± 14.2 (23.5–73.0)	44.5 ± 12.5 (27.5–68.9)	46.4 ± 14.5 (25.0–73.2)	.64
Handgrip strength, psi	19.9 ± 3.3 (14.5–25.0)	20.5 ± 3.3 (15.0–25.0)	20.2 ± 3.3 (14.5–25.5)	.72
Reaction time, ms	170 ± 20 (141–207)	170 ± 15 (153–192)	167 ± 17 (139–193)	.79
Number of push-ups completed	33 ± 15 (14–55)	32 ± 16 (13–57)	32 ± 16 (11–58)	.75

Data are mean ± SD (range). There was no significant difference in any of the physical performance tests among the 3 conditions.

Statistical analyses were performed using SPSS version 25.0 (IBM, Armonk, NY, USA). The  $\alpha$  value was set at 0.05. Means and standard deviation values are reported as mean ± SD.

## RESULTS

Eight healthy participants (1 female; 7 males, mean age  $28 \pm 5$  years; mean height  $177 \pm 5$  cm, mean body mass index  $25.9 \pm 3.9$  kg/m<sup>2</sup>) from Montreal, Quebec, Canada, were recruited and volunteered to participate. Of the 8 healthy participants, 2 were a couple (man and woman). Each of the remaining 6 participants had a partner who was not involved with the study other than having sex with the participant. Mean blood pressure at baseline was normal (SBP =  $115 \pm 10$  mmHg; diastolic blood pressure =  $71 \pm 6$  mmHg). All participants could complete all tests. On the night of sexual activity, all participants reported achieving orgasm through sexual intercourse with a partner. The mean HR during sexual activity was  $103 \pm 21$  beats/minute, with a range of 88–145 beats/minute. The mean estimated energy expenditure was  $130 \pm 44$  kcal (range, 53–190 kcal). The sexual activity lasted an average of 13 minutes. Participants reported sleeping an average of 7.6 hours in the control and sexually active conditions and 6.8 hours in the yoga condition. The difference was not statistically significant ( $P = .19$ ).

The total orgasm score following the night of sexual activity ranged from 66 to 106 (median, 87). There was a negative association between the total score on the orgasm scale and SBP following the morning of sexual activity (Spearman's  $\rho = -0.86$ ;  $P = .007$ ). For every 2.3-unit ( $\sim 2\%$ ) increase in the total orgasm score, SBP decreased by 1 mmHg ( $P = .02$ ). This suggests that the more

intense and pleasurable the orgasm on the night of sexual activity, the lower the SBP the morning after.

The mean values for the physical performance tests across the 3 conditions are reported in Table 1. The changes between conditions are reported in Table 2. We were unable to demonstrate a statistical difference in physical performance across the 3 conditions.

## DISCUSSION

The purpose of this study was to examine the effect of sexual activity on various measures of physical exercise performance. We understood that this was a preliminary study, and that the data collected here could be used for future sample size calculations. The results suggest a failure to identify significant changes in any of the physical performance measures in any of the 3 conditions. Specifically, sexual intercourse on the night before a battery of physical exercise performance tests did not seem to alter performance in any of the 5 tests compared with the abstinence or yoga condition. However, on the morning following sexual activity, participants with the highest total orgasm rating scores also had the lowest SBP.

There are few studies in the peer-reviewed literature examining the influence of sexual activity on physical exercise performance. In 1968, Warren Johnson was the first scientist to publish a paper on this topic. In his short-published report using 14 married male athletes, he demonstrated that engaging in sexual intercourse the night before an athletic task did not affect the strength or

**Table 2.** Changes in the physical exercise performance tests among conditions

Fitness test	Control (abstinence) condition minus the sexual activity condition	Control (abstinence) condition minus the yoga condition
PWC <sub>170</sub> , W	2 ± 19 (–12 to 18)	5 ± 9 (–1 to 10)
Standing vertical jump height, cm	0.4 ± 13.8 (–6.7 to 7.5)	–1.5 ± 2.8 (–3.4 to 0.2)
Handgrip strength, psi	–0.6 ± 1.1 (–1.5 to 0.1)	–0.3 ± 2.6 (–2.2 to 1.6)
Reaction time, ms	0 ± 20 (–11 to 11)	3 ± 18 (–7 to 13)
Number of push-ups completed	1.4 ± 3.7 (–0.3 to 3.1)	1.0 ± 6.2 (–2.1 to 4.7)

Data represent mean ± SD of the change. Values in parentheses represent the 95% bias-corrected and accelerated bootstrapped CI of the change. This CI corrects for the bias and skewness in the distribution of bootstrap estimates. Bootstrapping allows for inference about a population from the sample data. There was no significant difference in any of the physical performance tests among the 3 conditions ( $P > .05$ ).

endurance of the palmar flexor muscles using a hand-grip dynamometer.<sup>11</sup> Later, in 1995, Boone and Gilmore reported similar findings as Johnson's, in that at 12 hours after sexual activity, 11 male participants showed no statistical differences in cardiorespiratory exercise performance compared with a control condition.<sup>13</sup> Another study published in 2000 examined the effect of sexual intercourse on cardiorespiratory exercise performance. In that study, neither variables of cardiorespiratory exercise performance or mental concentration were statistically affected at 2 hours after sexual intercourse or 10 hours after sexual intercourse (intercourse lasting 15–30 minutes), compared with a control condition.<sup>12</sup> However, 5- and 10-minute postexercise HRs were approximately 7 beats/minute higher compared with the control condition when sexual intercourse occurred 2 hours before the cardiorespiratory exercise test.<sup>12</sup> In 2018, 12 men had their lower body muscle force evaluated using an isokinetic dynamometer at 12 hours after sexual activity.<sup>15</sup> No difference in muscle force was seen between the abstinence and nonabstinence conditions. Another study, published in 2018 (which was based on data from a 1987 master's thesis), examined strength, balance, agility, reaction time, anaerobic power, and maximal oxygen uptake in 10 young men.<sup>16</sup> There was also a failure to demonstrate statistical differences in exercise performance between the sexual activity and abstinence conditions.<sup>16</sup> Thus, the pattern is consistent across these 5 small studies, demonstrating a failure to demonstrate that sexual activity the night before exercise (or 2 hours before exercise) affects physical exercise performance.

This sixth study significantly adds to the limited data examining sexual activity and exercise performance. One strength of this study is the inclusion of many physical exercise performance tests. Measures of muscular power (vertical jump), muscular strength (hand-grip), musculoskeletal endurance (push-ups), cardiorespiratory exercise performance (PWC<sub>170</sub>), and reaction time (mental concentration and acuity) were performed. Another study strength is the recording and reporting of orgasm ratings. Here, ~50% of the variance in total orgasm scores was associated with SBP measured on the day after sexual activity. Other work has demonstrated the beneficial effects of sexual activity in reducing blood pressure.<sup>28</sup> A novel aspect of this study was the inclusion of another (nonsexual) exercise arm. The purpose of including yoga as a third condition was to imitate the energetic cost of sexual activity without arousal. Yoga is known to relax the mind and body. The relaxational properties of yoga might be expected to have a similar effect on blood pressure and orgasm; however, this was not found. In fact, there was no association between 15 minutes of yoga and blood pressure measured on the following morning.

There are some limitations in the literature. First, there is a gender bias. Except for the single female in this study, previous studies used only male participants.<sup>11–13,15,16</sup> It was difficult to recruit women for this study. Follow-up with a subset of female participants is needed. Second, none of the studies, including the present study, examined the effect of sexual activity on actual athletic performance. For example, does sex affect running times

or swimming performance? There is one study published in an obscure electronic journal reporting no correlation between the number of sexual events engaged in 48 hours before running a marathon and comparative running performance<sup>14</sup>; however, that report did not specify actual marathon times or the number of sexual events within 48 hours of the marathon. That study was merely an evaluation of a questionnaire provided by the investigator. More investigations are needed using real-world performance measures. A third limitation is small sample size ( $n = 8$ ). Given the nature of the research question, difficulty in recruiting willing participants was expected and occurred. Perhaps financial compensation could be offered in subsequent studies to enhance recruitment; however, paying people to have sex as part of a scientific research study may be controversial.

Five studies have presented actual physical performance scores before and after sexual activity.<sup>11–13,15,16</sup> This sixth study adds to the scientific literature on this topic, and any additional data, albeit limited, should be welcomed.

## CONCLUSION

In conclusion, our present findings show no significant changes in various measures of physical exercise performance following sexual intercourse at 7.6 hours before physical exercise. However, it was found that the more intense and pleasurable the orgasm from sexual intercourse the night before exercise, the lower the SBP.

## ACKNOWLEDGMENTS

We thank the research subjects for participating in this study. The data for this study were obtained from the 2011 Master's thesis by Eleftherios Vouyoukas titled "The Influence Of Sexual Activity on Athletic Performance," Department of Exercise Science, Faculty of Arts and Science, Concordia University, Montreal, Quebec, Canada (<https://spectrum.library.concordia.ca/35939/>). The thesis had some errors; this manuscript represents the amendments to these errors.

**Corresponding Author:** Gerald S. Zavorsky, PhD, FACSM  
E-mail: [gerryzavorsky@gmail.com](mailto:gerryzavorsky@gmail.com)

*Conflicts of Interest:* The authors report no conflicts of interest.

*Funding:* None.

## REFERENCES

1. Wakefield JC, Shipherd AM, Lee MA. Athlete superstitions in swimming: Beneficial or detrimental. *Strategies* 2017; 30:10-14.
2. Burke KL, Czech DR, Knight JL, et al. An exploratory investigation of superstition, personal control, optimism, and pessimism in NCAA Division I intercollegiate student-athletes; Available at:

- <http://www.athleticinsight.com/Vol8Iss2/Superstition.htm>; Accessed October 5, 2018.
3. Buhrmann H, Brown B, Zaugg M. Superstitious beliefs and behavior: A comparison of male and female basketball players. *J Sport Behav* 1982;5:175-185.
  4. Cooper DL. Can scoring influence athletic performance? Sex and the athlete. *J Am College Health* 1975;23:197-199.
  5. Fischer GJ. Abstention from sex and other pre-game rituals used by college male varsity athletes. *J Sport Behav* 1997;20:176-184.
  6. Gordon M. College coaches' attitudes toward pregame sex. *J Sex Res* 1988;24:256-262.
  7. Thornton JS. Sexual activity and athletic performance: Is there a relationship? *Phys Sportsmed* 1990;18:148-154.
  8. Anshel MH. Effects of sexual activity on athletic performance. *Phys Sportsmed* 1981;9:64-68.
  9. McGlone S, Shrier I. Does sex the night before competition decrease performance? *Clin J Sport Med* 2000;10:233-234.
  10. Chidley J. Sex and the modern athlete. *Maclean's Magazine* 1996;109:36-37.
  11. Johnson WR. Muscular performance following coitus. *J Sex Res* 1968;4:247-248.
  12. Sztajzel J, Périat M, Marti V, et al. 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. *J Sports Med Phys Fitness* 2000;40:233-239.
  13. Boone T, Gilmore S. Effects of sexual intercourse on maximal aerobic power, oxygen pulse, and double product in male sedentary subjects. *J Sports Med Phys Fitness* 1995;35:214-217.
  14. Anderson PB, Wei P, Shyu I. The relationship between sexual activity (and four other health behaviors) and marathon performance among non-elite runners. *Electronic J Hum Sex* 2001;4. Available at <http://www.ejhs.org/volume4/sports3.htm>. Accessed October 5, 2018.
  15. Valenti LM, Suchil C, Beltran G, et al. Effect of sexual intercourse on lower extremity muscle force in strength-trained men. *J Sex Med* 2018;15:888-893.
  16. Zavorsky GS, Newton WL. Effects of sexual activity on several measures of physical performance in young adult males. *J Sports Med Phys Fitness*; E-pub ahead of print, <https://doi.org/10.23736/S0022-4707.18.09070-9>.
  17. Li T, Yu T, Hawkins BS, et al. Design, analysis, and reporting of crossover trials for inclusion in a meta-analysis. *PLoS One* 2015;10:e0133023.
  18. Bohlen JG, Held JP, Sanderson MO, et al. Heart rate, rate-pressure product, and oxygen uptake during four sexual activities. *Arch Intern Med* 1984;144:1745-1748.
  19. Ray US, Pathak A, Tomer OS. Hatha yoga practices: Energy expenditure, respiratory changes and intensity of exercise. *Evid Based Complement Alternat Med* 2011;2011:241294.
  20. Mah K, Binik YM. Do all orgasms feel alike? Evaluating a two-dimensional model of the orgasm experience across gender and sexual context. *J Sex Res* 2002;39:104-113.
  21. Burke EJ. Validity of selected laboratory and field tests of physical working capacity. *Res Q* 1976;47:95-104.
  22. Harman EA, Rosenstein MT, Frykman PN, et al. Estimation of human power output from vertical jump. *J Strength Cond Res* 1991;5:116-120.
  23. Bohannon RW. Hand-grip dynamometry provides a valid indication of upper extremity strength impairment in home care patients. *J Hand Ther* 1998;11:258-260.
  24. Bohannon RW. Hand-grip dynamometry predicts future outcomes in aging adults. *J Geriatr Phys Ther* 2008;31:3-10.
  25. Haward BM, Griffin MJ. Repeatability of grip strength and dexterity tests and the effects of age and gender. *Int Arch Occup Environ Health* 2002;75:111-119.
  26. Del Rossi G, Malaguti A, Del Rossi S. Practice effects associated with repeated assessment of a clinical test of reaction time. *J Athl Train* 2014;49:356-359.
  27. ACSM's guidelines for exercise testing and prescription. 9th ed. Baltimore, MD: Lippincott Williams & Wilkins; 2014.
  28. Brody S. Blood pressure reactivity to stress is better for people who recently had penile-vaginal intercourse than for people who had other or no sexual activity. *Biol Psychol* 2006;71:214-222.

## SUPPLEMENTARY DATA

Supplementary table related to this article can be found at <https://doi.org/10.1016/j.esxm.2018.12.002>.