SEXUAL MEDICINE REVIEWS REVIEW

The Effects of Exercise on Sexual Function in Women

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ABSTRACT

Background: Acute exercise is associated with transient changes in metabolic rate, muscle activation, and blood flow, whereas chronic exercise facilitates long-lasting adaptations that ultimately improve physical performance. Exercise in general is known to improve both physical and psychological health, but the differential effects of brief bouts of exercise vs long-term exercise regimens on sexual function are less clear.

Aim: The purpose of this review was to assess the direct and indirect effects of both acute and chronic exercise on multiple domains of sexual function in women.

Methods: A literature review of published studies on exercise and sexual function was conducted. Terms including "acute exercise," "chronic exercise," "sexual function," "sexual arousal," "sexual desire," "lubrication," "sexual pain," and "sexual satisfaction" were used.

Outcomes: This review identifies key relationships between form of exercise (ie, chronic or acute) and domain of sexual function.

Results: Improvements in physiological sexual arousal following acute exercise appear to be driven by increases in sympathetic nervous system activity and endocrine factors. Chronic exercise likely enhances sexual satisfaction indirectly by preserving autonomic flexibility, which benefits cardiovascular health and mood. Positive body image due to chronic exercise also increases sexual well-being. Though few studies have examined the efficacy of month-long exercise programs for the treatment of sexual dysfunction, exercise interventions have alleviated sexual concerns in 2 specific clinical populations: women with anti-depressant-induced sexual dysfunction and women who have undergone hysterectomies.

Conclusions: This review highlights the positive effects of acute and chronic exercise on sexual function in women. Directions for future research are discussed, and clinicians are encouraged to tailor specific exercise prescriptions to meet their patients' individual needs. **Stanton AM, Handy AB, Meston CM, et al. The Effects of Exercise on Sexual Function in Women. Sex Med Rev 2018;XX:XXX–XXX.**

Key Words: Female Sexual Function; Acute Exercise; Chronic Exercise; Sexual Dysfunction

INTRODUCTION

The benefits of exercise on both physical and mental health are well documented in the scientific literature and are frequently conveyed by popular media. According to the American College of Sports Medicine, exercise and physical activity decrease the risk of developing congenital heart disease, stroke, type 2 diabetes, and some forms of cancer.[1] Exercise also contributes to the prevention and improvement of mild to moderate depressive and anxiety disorders, enhances cognitive function, and improves quality of life.[1] However, the relationship between exercise and sexual function has received significantly less attention than the effects of exercise on physical and mental health. Though the connection between sexuality and exercise is perhaps less intuitive, many of the physiological mechanisms involved in exercise are also implicated in female sexual function. If there is a significant relationship between exercise and improvements in sexual health, exercise could be a particularly appealing form of treatment for sexual concerns, as it does not carry the stigma that is often associated with sex therapy and pharmacotherapy. Individuals may avoid seeking help for a sexual concern due to discomfort, shame, or fear of not being taken seriously by their providers. Primary care providers often find it challenging to talk about sexual matters in the exam room, which could result in missed opportunities for prevention and intervention.[2,3] Given these challenges, exercise may be an attractive treatment option, either as a stand-alone intervention or as a complement to other forms of treatment.

Exercise has both an acute phase, during which homeostatic adjustments occur, and a more chronic phase, which is

Received September 12, 2017. Accepted February 12, 2018.

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https://doi.org/10.1016/j.sxmr.2018.02.004

accompanied by long-term physiological adaptations. During and immediately following a bout of exercise, there are metabolic and neuromuscular changes that are proportional to increases in metabolic rate. Oxygen consumption, an index of metabolic rate, can increase from around 3 mL oxygen/kg/min at rest to between 50 and 70 mL oxygen/kg/min, depending on an individual's average level of physical activity.[4] A few hours after exercise, oxygen consumption returns to baseline. These metabolic changes are transient. Other changes that occur in order to meet the demands of increased metabolic rate include altered blood flow to the active muscles, increased heart rate, increased breathing rate, secretion of stress hormones (eg, adrenocorticotropic hormone, cortisol, catecholamines), and increased body temperature.[5] These changes maintain the constancy of the body's internal state during exercise.[4]

When exercise is repeated regularly, chronic changes occur as early as a few weeks following the start of a new regimen.[4] The nature of these more long-term changes depends on the type of exercise. A long-distance runner, for example, will experience different neuromuscular changes following months of training than will a wrestler. The chronic effects of exercise are also influenced by an interaction of several other important factors, such as previous exposure to the activity, the type of muscle action, and duration of the activity. Individual differences in responses to the same exercise stimulus affect the speed at which long-term adaptations occur.[6] Variations in the timing and composition of food intake and the absorption of nutrients may also impact chronic adaptations. For example, eating carbohydrates or a combination of carbohydrates and protein reduces the expression of genes involved in lipid metabolism,[7] and there have been significant differences in training adaptation following dietary interventions.[8] Acting together, these factors influence the pathways that are involved in protein synthesis or degradation, leading to changes in performance.

Chronic exercise regimens typically emphasize either endurance (aerobic) training or strength (resistance) training. Endurance training improves resistance to fatigue by increasing the maximal oxygen uptake ($V0_{2max}$).[4] Increases in $V0_{2max}$ result from changes to muscle properties following training, enabling individuals to take on an increased physiological "workload" during subsequent exercise.[9] Unlike endurance training, strength training increases muscle strength, or the amount of force that is produced by a given muscle. Muscle strength improves over time when individuals use resistance bands, machine weights, or free weights to manipulate the intensity and number of repetitions as well as the length of the recovery period between repetitions.[10]

Given the differences in the effects of acute and chronic exercise, this review addresses both types of exercise in relation to female sexual function. We pay particular attention to the domains that appear to be most impacted by exercise: sexual arousal, desire, and satisfaction. Sexual arousal has both a physiological (ie, genital) and a subjective (ie, being mentally "turned on") component, both of which are associated with increased engagement (physiological or cognitive) in response to a sexual stimulus.[11] Desire is more indicative of motivation to engage in or be receptive to a sexual event, and satisfaction reflects the fulfillment of one's sexual wishes, expectations, or needs.[11] This review also highlights populations with specific types of sexual dysfunction that may benefit from exercise interventions.

THE EFFECTS OF ACUTE EXERCISE ON PHYSIOLOGICAL SEXUAL AROUSAL

Over the past 2 decades, research has demonstrated a strong link between acute exercise and increased physiological (ie, genital) sexual arousal in women. Acute exercise influences a number of bodily systems that could feasibly impact women's physiological sexual arousal. Exercise has been shown to positively affect a variety of hormones such as cortisol,[12] estrogen,[13] prolactin,[14] oxytocin,[15] and testosterone,[16,17] all of which have been linked to arousal, some more strongly than others. The effects of exercise on hormonal responses in women vary based on the type of exercise and, for pre-menopausal women, the menstrual cycle. 1 Study found that moderate- to high-intensity (60−80% $V0_{2max}$) exercise provokes increases in circulating cortisol levels, whereas low-intensity (40% $V0_{2max}$) exercise leads to a reduction in circulating cortisol levels.[12] In another study, 30 minutes of exercise at 60% $V0_{2max}$ during the luteal phase resulted in significant increases in estradiol; this was not the case during menses.[18] More recent work has demonstrated that an exercise regimen of 150 minutes of moderate to vigorous aerobic exercise over a 16-week period resulted in significant changes in estrogen metabolism.[13] Prolactin also increases post-exercise. In a small sample of women runners, prolactin concentrations increased significantly following physical activity.[19] There is also evidence for increased oxytocin following prolonged *endurance* exercise; oxytocin levels do not increase following short bursts of high-intensity exercise or steady runs on a treadmill.[15] The effects of exercise on testosterone also depend on the type of exercise. Testosterone does not tend to increase following resistance exercise,[20,21] but it is elevated after aerobic exercise in pre-menopausal women.[22]

These hormones either have direct or indirect effects on sexual arousal function in women. Hamilton and colleagues[23] found that some women experience an increase in cortisol during sexual arousal. Women who exhibited this pattern tended to have lower scores on the arousal domain of the Female Sexual Function Index. The authors of this study suggested that a laboratory test of sexual responding might be more stressful for women who have experienced arousal dysfunction. Estrogen is known to play a significant role in the regulation of female sexual arousal function. Estradiol levels influence nerve transmission and affect cells in both the peripheral and central nervous systems. Chronic decreases in serum estrogen levels result in the thinning of the vaginal epithelium and the atrophy of vaginal wall smooth muscle, which lead to a decrease in vasodilation and ultimately to