Physical activity and male fertility: finding the sweet spot

The steady decline in male fertility rates has been a subject of concern in research, clinical settings, and public health policy realms. This decline in sperm quality has been attributed to various changes in environmental and lifestyle factors. Consequently, addressing modifiable factors, such as physical activity, continues to be a critical aspect of patient care and counseling in ongoing fertility management.

The relationship between physical activity and semen quality is complex, particularly regarding exercise intensity. A cross-sectional study on healthy young men found that moderate to vigorous physical activity had a positive effect on sperm concentration and total sperm count (1). Conversely, the study also showed that men who spent more time watching television exhibited significantly worsening of the same semen parameters (1). In a similar study, Pärn et al. (2) used accelerometers to measure physical activity in primarily infertile patients and found that increased bouts of moderate to vigorous physical activity improved total sperm count, sperm concentration, and total motile sperm count. However, in the group with highest physical activity, there was a trend toward worsening semen parameters, although the study lacked sufficient power to establish statistical significance (2). Finally, a meta-analysis by Ibañez-Perez et al. (3) showed a trend toward improvement in semen parameters among men engaging in moderate- or high-intensity recreational physical activity, including a subgroup of men with infertility. Similarly, elite-level physical activity was found to have a negative impact on semen quality, supporting the notion of an inverse U-shaped correlation between exercise intensity and semen quality (3).

We read the article by Donato et al. (4) with great interest. Conducted as part of the Fertilità, Ambiente, alimentazione, STile di vita (FAST) randomized controlled trial, which had previously shown that a 4-month Mediterranean diet and moderate physical activity program led to improvements in sperm concentration, total and progressive motility, and the proportion of normal morphology cells in the intervention group (5). Additionally, the study demonstrated that adherence to a Mediterranean diet and increased physical activity enhanced the total antioxidant capacity in healthy young males (5).

In this particular analysis, Donato et al. (4) conducted a stratified evaluation of the FAST study population, examining how varying intensities of physical activity influenced semen quality over an 8-month period. They identified an inverse U-shaped correlation between exercise intensity and sperm motility and morphology in normal-weight, nonsmoking, non–alcohol-drinking, healthy young men. Moderate physical activity (600–2,999 metabolic equivalent task (MET)-minute/wk) was associated with a statistically significant improvement in progressive sperm motility, and there was a trend toward improvement in total sperm motility and morphology, although these trends did not reach statistical significance (4). On the other hand, both low-intensity activity (<600 MET-minute/wk) and vigorous activity (>3,000 MET-minute/wk) were linked to a significant deterioration in sperm motility, with a trend toward worsening sperm morphology. No significant correlation was found between exercise intensity and sperm concentration (4).

This new study has several notable strengths, beginning with its prospective design. By selecting healthy participants with normal body mass index from a homogenous group of high school and university students, the researchers were able to minimize confounding factors, thereby increasing the reliability of the findings. Additionally, they used the validated International Physical Activity Questionnaires, a widely recognized tool for measuring physical activity levels. Another strength is the collection of semen samples at 2 different time points, which adds to the robustness and validity of the results.

However, the study also has limitations. The investigators appropriately acknowledged the challenges associated with using a self-reported questionnaire, as opposed to objective measures such as accelerometers or health trackers, which introduces the potential for significant recall bias. Moreover, the International Physical Activity Questionnaires only capture physical activity from the past week, which may not accurately reflect participants' usual activity levels over time. Other confounding factors, such as stress levels, sleep, diet, and testicular volume, were not considered in this study. Additionally, the strict inclusion criteria limit the external validity and generalizability of the findings to broader populations. Indeed, the average patient seeking infertility consultation often presents with more complex medical histories and risk factors such as advanced age, obesity, and smoking. Finally, because this study was part of the FAST trial, which included dietary counseling for some participants, it is difficult to determine how much of the observed improvement in semen quality is attributable to exercise intensity vs. dietary changes.

The inverse U-shaped correlation between exercise intensity and semen quality can be explained by the phenomenon of hormesis, where moderate exercise promotes health benefits, whereas limited or excessive exercise leads to harm. Moderate activity is believed to improve sperm quality through mechanisms such as enhanced circulation, reduced oxidative stress, and better hormone regulation. In contrast, excessive exercise may increase oxidative stress, disrupt the hypothalamic-pituitary-gonadal axis, and increase cortisol levels, negatively impacting sperm production. This highlights the need for balanced physical activity to optimize fertility benefits.

The importance of physical activity in male fertility should lead physicians and other healthcare professionals to encourage moderate physical activity as part of fertility counseling while carefully educating patients about the harms associated with both too much and/or too little exercise. We hypothesize that personalized exercise programs, considering factors such as individual health, stress levels, and comorbidities, are likely to further improve the efficacy of these interventions. Public health efforts should emphasize the importance of balanced exercise for reproductive health,

offering clear guidelines on the optimal levels of activity for men trying to conceive.

To better understand the link between exercise and semen quality, larger, more diverse studies including participants with varying health profiles are necessary. The use of objective physical activity measures, such as accelerometers, will reduce bias from self-reported data. Future studies should also examine confounding factors such as diet, sleep, and stress.

In conclusion, research shows a complex relationship between exercise and male fertility, with a "sweet spot" of moderate physical activity offering the greatest benefits for sperm quality. Although moderate exercise improves sperm parameters, excessive exercise can have harmful effects. Clinicians should recommend balanced physical activity tailored to individual needs, emphasizing the benefits of staying within this optimal range. Future studies should focus on including more diverse patient populations and using objective measures to further understand how exercise influences fertility.

CRediT Authorship Contribution Statement

Iman Sadri: Investigation, Writing – original draft. **Mana Almuhaideb:** Investigation, Writing – original draft. **Francis Petrella:** Conceptualization, Writing – review & editing.

Declaration of Interests

I.S. has nothing to disclose. M.A. has nothing to disclose. F.P. has nothing to disclose.

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