Effects of physical exercise on male reproductive health

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ABSTRACT

Regular physical exercise seems to have a positive impact on seminal parameters. However, performing intense activities can lead to significant changes in these parameters. This aspect is particularly relevant given that an increasing number of people around the world are engaged in physical activity. In addition, the rate of marital infertility ranges from 8% to 10%, with up to 50% of cases attributed to male factors. Given this scenario, the study in question conducted a comprehensive analysis of the current literature to investigate the impact of physical activity on male reproductive health. A systematic review was conducted using the PRISMA guidelines for searching, selecting, and extracting data from PubMed databases. A total of 261 articles were identified, of which 13 were selected according to the established flowchart. Based on substantial clinical evidence, this review suggests that intense physical activity can induce significant hormonal changes and negatively affect seminal quality. In contrast, regular exercise appears to have a neutral or even beneficial effect. In addition, the impact of physical activity on semen quality can vary depending on the type of exercise performed. Despite these observations, there is still a lack of consensus on the subject, due to the contradictions between studies and the difficulty in quantifying physical activity precisely.

Keywords: Semen, Infertility, Physical exercise.

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INTRODUCTION

The increasing adoption of an active lifestyle has been encouraged as a strategy to improve overall health, reduce stress, and promote a better quality of life for people of all ages and genders (WHO, 2020). However, it is important to consider that the practice of physical activity (PA) can also bring negative effects, such as physical overload, imbalances in the body and muscle injuries. Therefore, it is essential to investigate how FA can influence semen quality.

Male reproductive health, including aspects such as semen quality and fertility, can be affected by several factors, such as age, lifestyle, environment, alcohol consumption, smoking, stress, obesity, and sedentary lifestyle. In addition, PA can also impact these parameters (AL-DAGHESTANI et al., 2023; HAMZAH et al., 2022).

Given that marital infertility affects up to 15% of the world's population, with male contribution in up to half of cases, the question arises of how PA interacts with male reproductive health (AL-DAGHESTANI et al., 2023). Research with female athletes, especially runners, suggests that the practice of intense physical exercise can lead to changes in the menstrual cycle and disorders such as delayed pubertal development, luteal phase defects, anovulation, and amenorrhea (PRATHER; HUNT, 2015).

Evidence on the relationship between PA and seminal quality is mixed. Some studies have identified positive associations between PA and semen quality (GASKINS et al., 2022; JONES et al., 2023), while others report negative associations (SMITH et al., 2021) or neutral effects (MINGUEZ-ALARCON et al., 2024). Despite advances in the field of andrology, the exact impact of PA on male fertility is not yet fully defined, due to discrepancies between studies and the difficulty of measuring PA accurately.

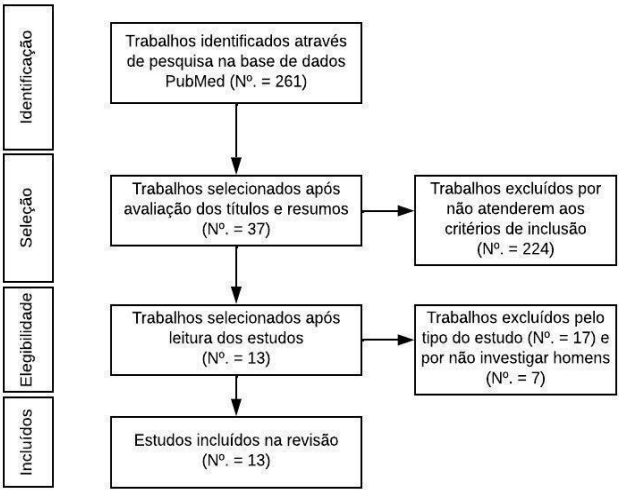
In this context, regular PA practice appears to be beneficial for male reproductive health, while excessively intense exercise may have adverse effects. Different types of sports activities can also influence male fertility (DENHAM et al., 2020; KIPANDULA; LAMPIAO, 2021), but more research is needed to reach more definitive conclusions on the topic (LALINDE-ACEVEDO et al., 2022).

METHODOLOGY

A systematic review was conducted using the *PubMed* database to identify articles investigating the effect of physical activity on male reproductive health. The search was performed with the terms *"(Semen Quality or Fertility or Seminal Parameters) and (Physical Activity or Physical Exercise)",* in line with the descriptors used by the Virtual Health Library (*DeCS).* No restrictions were imposed on the year of publication, and only full articles in English were included, with the last update of the survey taking place in June 2024. To ensure the quality and transparency

of the review, we follow the guidelines of the Preferred *Reporting Items for Systematic Reviews and Meta-Analysis* (*PRISMA*) Checklist (MOHER et al., 2009). The criteria for inclusion of studies were: a) original articles published in scientific journals; b) complete availability in English; c) indexing in the searched database; d) focus on the impact of physical activity on semen quality or male fertility. The following were excluded: a) case reports, reviews, comments, or articles in other languages; b) studies involving non-human or exclusively female populations. The screening of relevant articles involved the evaluation of titles, abstracts and full texts by two independent reviewers. Of the 261 articles initially identified, 13 were selected for inclusion in the review, as illustrated in Figure 1, following the recommendations of *PRISMA* (MOHER et al., 2009). The information extracted from each study included: author, year of publication, type of research, objective, WHO criteria, type and intensity of physical activity, number of participants, and main findings.

Figure 1 – Flowchart for the identification and selection of articles for a systematic review on the effect of physical activities on male reproductive health



Source: Prepared by the author Nesello (2024)

RESULTS

Chart 1 presents the 13 studies selected for analysis. A review of these studies reveals a substantial growth in the number of publications in the last decade (n = 12; 92.3%). Among them, seven (53.8%) followed the most recent WHO guidelines (2010) for seminal parameters. Most of the research was conducted in developed countries (n = 10; 76.9%). There was a large variation in the samples, with six studies (46.2%) ranging from 107 to 2261 participants and the other seven (53.8%) with samples ranging from seven to 31 individuals. All participants were aged between 18 and 40 years, an age group associated with greater fertility.

The most studied sports modalities were running (KARKOULIAS et al., 2008; SAFARINEJA et al., 2009; CASTO et al., 2014) (n = 3; 23.1%) and cycling (WISE et al., 2011;

GASKINS et al., 2014; TARTIBIAN; MALEKI, 2015) (n = 3; 23.1%). Other activities, although less frequent, were also analyzed, such as walking on a treadmill (MALEKI; TARTIBIAN, 2017), outdoor exercises (GASKINS et al., 2014), basketball (MARTÍNEZ et al., 2010), combat sports (TARTIBIAN; MALEKI, 2012), weightlifting (GASKINS et al., 2014), mountaineering (VERRATTI et al., 2016), water polo (VAAMONDE et al., 2009), tennis (IBAÑEZ-PEREZ et al., 2019) and triathlon (VAAMONDE et al., 2009; VAAMONDE et al., 2019). Exercise intensity varied, with five studies (38.5%) focusing on moderate intensity and eight studies (61.5%) on high intensity.

The variety in modalities and intensities makes it challenging to draw definitive conclusions. However, most preliminary evidence suggests that regular physical activity has no significant impact on male reproductive health. Cycling, specifically, is often associated with possible negative effects on the male reproductive system (GASKINS et al., 2014; TARTIBIAN; MALEKI, 2015), due to mechanical stress in the scrotum region during exercise, the use of tight clothing and the increase in the temperature of the genitals. Among the studies reviewed, only three focused on cycling, all reporting adverse effects on sperm concentration. However, the differences in hormonal profiles between cyclists and athletes in other sports are still inconsistent.

For other forms of physical activity, it seems that the intensity of exercise plays a crucial role. When the intensity is high, there is a tendency for male reproductive health indicators to decrease, suggesting a possible negative effect on fertility. In contrast, moderate-intensity exercise appears to be beneficial or have neutral effects on male reproductive health.

Chart 1 – Studies on the effect of physical activity on seminal quality.

Exercise	**Author (year)**	**No. Participants**	**Analysis**	**Results**
Treadmill Workouts	Maleki and Tartibian (2017)	433	Effect of intense exercise in sedentary and infertile patients. Pregnancy rate and live birth.	High-intensity training significantly increased sperm quality.
Outdoor activities	Gaskins et al. (2014)	231	Outdoor activity (≥1.5 h/week) vs. Control group of sedentary patients.	Men in the outdoor category had 42% higher sperm concentration, compared to sedentary men.
Basketball	Martínez et al. (2010)	26	Basketball competition season (2 times/week; 2-3 hrs basketball) vs. Control group of healthy, physically active individuals.	Basketball practice showed an initial transient increase in testosterone and cortisol during the competition season.
Cycling	Wise et al. (2011)	2.261	Cyclists (≤ 2 h/week; 3–4 h/week and ≥ 5 h/week) vs. Control group of sedentary patients.	Cycling ≥ 5 h/week was associated with lower sperm concentration and total motile sperm.
	Gaskins et al. (2014)	231	Cyclists (≥1.5 h/week) vs. Control group of sedentary patients.	Men who rode bicycles had 34% lower sperm concentrations compared to men who did not cycle.

	Order; Maleki (2015)	24	16 weeks of high-intensity cycling (eight weeks: 371 km/week; 12 h/week) plus (eight weeks: 659 km/week; 16 h/week) vs. WHO reference control group (2010).	Seminal cytosine levels increased and remained high after 30 days of recovery. Sperm volume, motility, morphology, concentration, and number decreased. All of the above-mentioned variables (with the exception of volume, motility, and concentration) decreased after 30 days of recovery.
Race	Karkoulias et al. (2008)	11	Blood samples collected 1 week before the race (marathon), directly after the completion of the race, and 1 week later.	The rush resulted in a sharp decline in testosterone level. The aforementioned changes returned to baseline a week later.
	Safarinejad et al. (2009)	286	60-week high-intensity running training (80% of VO2 max*) vs. Running at moderate intensity (60% of VO2 max*).	Subjects who ran at high intensity demonstrated significantly decreased semen parameters compared to those who exercised at moderate intensity.
	Casto et al. (2014)	25	Three saliva samples before warm-up, after warm-up, and immediately at the end of an 8K run.	Running was associated with a significant increase in salivary cortisol and testosterone.
Fight Sports	Order; Maleki (2012)	108	Wrestlers (62.3% of VO2 max*) vs. Physically active group (50.1% of VO2 max*).	Physically active men had significantly higher levels of seminal plasma oxidative stress and antioxidants, and a lower rate of sperm DNA fragmentation when compared to elite wrestlers.
Weightlifting	Gaskins et al. (2014)	231	Weightlifting (≥2 h/week) vs. Control group of sedentary patients.	Men in the weightlifting category had 25% higher sperm concentrations compared to sedentary men.
Mountaineering	Verratti et al. (2016)	7	Short exposure to hypoxia (5 days) combined with physical activity (mountaineering).	There was a significant reduction in motility after shipment. The other seminal parameters were not significantly altered.
Aquatic pole	Vaamonde et al. (2009)	30	Water polo players (54.2% of VO2 max*; 5 times/week; 90 min/session) vs. Physically active group (45.2% of VO2 max*; 3.3 times/week; 60 min/session).	Sperm concentration was higher for the physically active group. However, the total number of spermatozoa, as a function of concentration and volume, was higher in the water polo group. Sperm morphology was significantly lower for water polo players.
Tennis	Ibañez-Perez et al. (2019)	107	Tennis players (≤ 2 h/week; > 2 h/week) vs. WHO reference control group (2010).	Tennis sports activity did not show a significant correlation with semen quality for any seminal parameter in men from infertile couples.
Triathlon	Vaamonde et al. (2009)	31	Triathletes (64.0% of VO2 max*; 9.9 times/week; 122.6 min/session) vs. Physically active group (45.2% of VO2 max*; 3.3 times/week; 60 min/session).	The values for all parameters showed a tendency to be higher in the physically active group and lower for the triathlete group. Sperm morphology was significantly lower for the triathlete group.
	Vaamonde et al. (2018)	12	Two weeks of intense triathlon training.	High levels of resistance training performed by the triathletes caused a negative correlation for sperm DNA.

Source: Prepared by the author Nesello (2024)

DISCUSSION

MALE INFERTILITY

Marital infertility is defined as a couple's difficulty conceiving after one year of unprotected sex. Approximately 90% of couples manage to get pregnant in the first year, and 95% in the second year. Infertility affects between 8% and 15% of couples of reproductive age globally, with an equitable distribution between male and female factors (NUNES et al., 2021). The diagnosis of male infertility is usually based on the analysis of semen parameters, such as sperm concentration, motility, and morphology. However, semen analysis is only one part of a more comprehensive assessment, which should include a complete assessment of the couple (FONSECA et al., 2022). Male infertility may be associated with conditions such as oligozoospermia (reduced sperm count), asthenozoospermia (inadequate motility), and teratozoosmpermia (abnormal morphology), reflecting changes in sperm production and quality (SILVA et al., 2020). Factors such as sexually transmitted diseases and the postponement of motherhood contribute to this problem, affecting the quality of life of couples and impacting sexual satisfaction, psychological well-being, and emotional health (SILVA et al., 2020; OLIVEIRA et al., 2019).

EFFECT OF PHYSICAL ACTIVITY ON SEMEN QUALITY

PA refers to any voluntary, repetitive body movement that engages large muscle groups and increases energy expenditure above the resting level (Blair et al., 2023). The relationship between PA and male reproductive health can be complex. Although high-intensity physical exercise, such as treadmill running, can improve semen volume and sperm concentration (Denham et al., 2022; Fernández-García, 2020), intense practice can also reduce the proportion of sperm with normal morphology (Fernández-García, 2020). The lack of a clear association between PA and semen quality can be explained by variations in the level and intensity of PA. Recent studies address these issues in populations with fertility problems and suggest that, despite the overall benefits of FA, strenuous exercise may pose a risk to male fertility (Jozkow & Rossato, 2021). The decrease in PA practice and the increase in sedentary behavior may be contributing to the decline in semen quality observed in recent decades.

INTENSITY AND VOLUME OF PHYSICAL ACTIVITY RELATED TO SEMEN

Studies indicate that a controlled increase in exercise intensity can result in improvements in hormonal parameters and male reproductive health (SILVA et al., 2022). However, when the intensity of exercise exceeds certain limits, there can be a negative impact on semen quality, affecting aspects such as sperm motility, concentration, and morphology (RODRIGUES et al., 2020; PEREIRA et al., 2021). Physical activity must reach a minimum intensity to bring benefits to reproductive health

(MENDES et al., 2019), but the ideal intensity is not yet clearly established for the prevention or treatment of male infertility (OLIVEIRA et al., 2023). Studies suggest that moderate levels of physical activity tend to improve semen quality compared to very low or very high levels (SILVA et al., 2022). However, variation in training intensities in relation to exercise goals can affect results (RODRIGUES et al., 2020).

IMPACT OF OBESITY AND SEDENTARY LIFESTYLE ON SEMINAL QUALITY

Obesity and sedentary behavior have been identified as critical factors that adversely affect seminal quality. Recent research suggests that a sedentary lifestyle, characterized by long periods of inactivity and working in low-activity environments, is associated with changes in sperm quality. Studies indicate that prolonged time in front of the television is correlated with a reduction in total sperm concentration in the seminal sample (OLIVEIRA et al., 2020; GONÇALVES et al., 2023). In addition, obesity, characterized by a high Body Mass Index (BMI), is often associated with hormonal changes that compromise seminal quality. Obese individuals have reduced testosterone levels and high estradiol levels, which can negatively impact semen quality (SILVA et al., 2021; RIBEIRO et al., 2022; SANTOS et al., 2023). Data from a study conducted in Brazil with 1,285 men show that obesity is associated with a decrease in semen volume, reduced sperm concentration, impaired motility, and increased morphological anomalies (SANTOS et al., 2023).

METABOLIC REPERCUSSIONS AND HORMONAL CHANGES RESULTING FROM THE PRACTICE OF PHYSICAL EXERCISE

Intense physical exercise can lead to significant reductions in plasma levels of testosterone and luteinizing hormone, as demonstrated in studies with male albino rats that performed prolonged swimming (Silva et al., 2023). Oxidative stress plays a crucial role, as increased exercise intensity can negatively impact semen quality. FA acts as a potent modulator of the endocrine system, affecting hormone secretion and influencing hypothalamic and testicular levels, as well as testosterone production (Rocha et al., 2022). Comparative studies show that high-intensity exercise is associated with a decrease in semen parameters, in contrast to moderate-intensity exercise (Santos et al., 2021). This evidence suggests that intense and prolonged practice can have adverse effects on reproduction. The evidence discussed in Chart 2 highlights that the response of seminal quality to PA is related to exercise intensity and volume, with low- to moderate-intensity PA possibly not causing significant hormonal changes, while intense PA may impair sperm parameters due to oxidative stress (Gomes et al., 2020).

Table 2 – Normal values of seminal parameters.

Seminal parameter	Normal values
Volume	≥ 1.5 ml
ph	7,2 - 8,0
Colour	Opaque white
Liquefaction	≤ 30 min, full
Viscosity	normal
Concentration	≥ 15 x 106 sperm per ml of sêmen
Total concentration	≥ 39 x 106 sperm per ejaculate
Progressive motility	≥ 32% with linear progression
Total motility	≥ 40%
Morphology	≥ 4% with normal forms
Vitality	≥ 58% of live forms

Source: Prepared by the author Nesello (2024)

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