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Exercise Intensity and Its Relation to Sperm Count on Healthy Male Adults

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ABSTRACT

Physical activity is well known for maintaining fitness and health. Recent studies also found that low semen quality and quantity are associated with the risk of many diseases and life expectancy. We conducted a literature search with key concepts of "exercise", "sperm count", and "adult". The search was carried out through comprehensive literature searches on 4 databases (Pubmed, Web of Science, Scopus, and Google scholar), reference searches or citation matching, and/or other method searches. The literature search was done in November 2022. We identified 17 literatures that analyzed these correlations. Among them, 7 articles showed that there is a correlation between exercise intensity and sperm count. However, there are other studies that showed no significant correlation between the intensity of exercise and sperm count. In conclusion, physical activity in sedentary adult males has shown a positive effect on sperm count. However, athletes showed no significant decrease in sperm count.

Keywords: sperm count; physical activity; exercise; adult male

INTRODUCTION

Physical activity is well known for maintaining fitness and health. Many doctors and physicians prescribe exercise as an effective way to increase individual health conditions. Almost all age categories get health benefits from doing exercise. WHO suggests that people should get at least 150 minutes of aerobic exercise and 2 times strength training per week. But there's a lot of people doing excess training that can cause several problems such as hormonal imbalance can even cause infertility because there is a decrease in sperm quality [1].

The most recent studies found that low semen quality and quantity is associated with the risk of many diseases and life expectancy. Semen quality can be an overall indicator of individual health status. Low semen quality can be the sign of male reproductive dysfunction. It can be caused by testicular or post-testicular deficiencies. Some factors include hormonal disorder, organic problems, environment factors and lifestyle factors. These factors have been known to be associated with semen quality [2].

One of which is the effect of exercise intensity and semen quantity. Therefore, our study intends to explain the correlations between exercise intensity and sperm count. This study will show how recreational exercise affects sperm count in healthy male adults, how intense exercise affects sperm count in healthy male adults, and how sperm count compares between physical activity and intense exercise groups.

METHODS

We conducted a literature search with key concepts of "exercise", "sperm count", and "adult". The search was carried out through comprehensive literature searches on 4 databases (Pubmed, Web of Science, Scopus, and Google scholar), reference searches or citation matching, and/or other method searches. The literature search was done in November 2022.

Studies were included in the review after a series of duplicate removal, title and abstract screening, and full-text screening. The selection of studies was done based on inclusion criteria (using English or Indonesian; healthy adult populations (18--59 years old); comparing any different intensities of exercise or physical activities; assess the effect of different exercise intensities on sperm count) and exclusion criteria (full-text can't be accessed).

The following data were extracted from included studies: first author, publication year, population characteristics and number of populations, exercise intervention (FITT: frequency, intensity, time, type), method of semen collection, and sperm count. Extracted data were summarized and presented narratively, using text and table.

The analyses and discussion were done descriptively based on the extracted data and/or other related references in order to answer the study objectives.

RESULTS

Initial literature search found 703 titles, resulting in a total of 436 titles once duplicates were removed. Three hundred and eighty-five literatures were excluded following an abstract review. A further 34 literatures were excluded following a full text review. In total, 17 literatures were included in this literature review.

TABLE 1: Effects of Exercise Intensity on Sperm Count.

	Study	n	Exercise (FITT)	Sperm count (mln/ejaculate)	Summary
1	Vaamonde et al., 2012	31	Two groups: physically active (PA, 16 subjects) and sedentary (SE, n = 15)	Physically active = 3.24 (±0.81) Sedentary = 3.19 (±0.74) p-value 0.783	Exercising at a moderate pace may result in a more proper environment for the sperm production processes
2	Montano et al., 2019	286	Physical activity questionnaires PREDIMED and IPAQ, respectively	INT = 2.74±1.38 CTRL = 2.72± 1.26 Whole cohort = 2.73±1.32 p-value 0.9137	Regular physical activity gives positive effects on sperm count in healthy young men
3	Ayers et al., 1985	20	All subjects had been running at least 30 miles (range, 30 to 80 miles) weekly for the past 18 months (range, 1.5 to 8 years) in preparation for competitive running	The mean sperm count in the 18 out of 20 men (2 severe oligospermia) was 128 x 106/ml	Physical exercise (40 to 80 miles/week) and chronic endurance training alone are not associated with a detrimental effect on sperm production in most men
4	Eisenberg et al., 2016	501	58% were reported to engage in physical activity, <1 time/week	BMI<25.00 = 9.0 (3.0, 20.0) 25.00– 29.99 = 9.0 (3.0, 17.0) 30.00– 34.99 = 9.0 (3.0, 18.0) ≥35.00 = 7.0 (2.0, 21.0) p-value 0.344	Physical activity is not related to sperm count
5	Gaskins et al., 2014	231	Men reported the average time per week during the preceding year spent on any of the following activities: walking, jogging, running, bicycling, swimming, tennis, squash, weightlifting, aerobics and moderate (e.g., yard work and gardening) and heavy (e.g., digging and chopping) outdoor work	Q1 = 114.4 (88.3, 148.2) Q2 = 119.1(91.6, 154.7) Q3 = 143.6 (109.6, 188.0) Q4 = 152.5 (116.6, 199.3) p-value 0.08	Physical activity did not significantly impact the sperm count
	Gaskins et al., 2013	189	Men in the highest quartile of moderate-to vigorous activity (≥15 hours/week) in 3 months given an average MET level of 2, 4.5, and 6 respectively to calculate the total METs per person	Total sperm count was directly related to physical activity after multivariable adjustment (p-trend=0.01 and 0.04)	Higher moderate -to-vigorous activity were significantly associated with higher total sperm count

	Study	n	Exercise (FITT)	Sperm count (mln/ejaculate)	Summary
6	Danielewicz et al., 2019	207	Participants were asked about average duration (in minutes) and frequency (days) they spent on four PA domains (work-related, transport-related, domestic and gardening (yard), leisure time) during the week prior to the appointment. PA was expressed as a sum of all activities (MET min/week) and as weekly time in which individuals spent on each type of PA intensity (min/week). A sum of the average time per week spent on sitting (at work and home, and while driving) expressed the sedentary time (h/week)	T1 = 74.1 (26.9; 162.9) T2 = 108.9 (49.4; 231.2) T3 = 124.5 (48.4; 306.3) p-value 0.019	Higher physical activity (PA) was related to higher sperm count
7	Minguez-Alarcón et al., 2015	215	Participants were asked to report the number of hours they spent in a normal week over the past 3 months engaged in vigorous, moderate or light exercise. Total activity was calculated as the sum of vigorous, moderate and light activity. Moderate-to-vigorous activity was calculated as the sum of those categories, respectively. We also calculated the total METs and moderate-to-vigorous METs. Mild (<3 METs), moderate (3–6 METS) and vigorous (>6 METs) activities were given an average MET level of 2, 4.5 and 6, respectively, to calculate the total METs per person (42). Total METs was calculated as the sum of vigorous, moderate and light METs. Also, moderate-to-vigorous METs was calculated as the sum of those METs categories, respectively	121.5 × 106 (65.4,212.7) for total sperm count (p-trend=0.83)	Physical activity is not related to sperm count
8	Arce et al., 1993	28	The sample population consisted of a cohort of three groups: endurance-trained runners, running a minimum of 96 km/wk for at least 12 months; resistance-trained weightlifters, performing a minimum of 2 hours of training per day at least 4 days per week for a minimum of 1 year; and sedentary males performing no more than 1 hour of aerobic activity per week for the past 12 month	Runners = 332 ± 74 Weightlifters = 342 ± 36 Controls = 376 ± 59 p-value 0.858	Endurance training, in the form of running, is associated with sperm count
9	Jozkow et al., 2017	177	Participants were asked to fill an international physical activity questionnaire (IPAQ) to record physical activity for the past week, defined as MET-min/wk, analyzed in quartiles. Q1 n = 45, Q2 n = 43, Q3 n = 43, Q4 n = 44	Q1 = 132.9 Q2 = 105.8 Q3 = 198 Q4 = 121.9 p-value 0.480	Physical activity is not related to sperm count

	Study	n	Exercise (FITT)	Sperm count (mln/ejaculate)	Summary
10	Ibanez-Perez et al., 2019	454	Participants were asked to fill an international physical activity questionnaire (IPAQ) to record physical activity for the past week, defined as MET-min/wk. Participants were divided into 4 groups: Low (<599 MET-min/week) n = 83, moderate (600–2999 MET-min/week) n = 169, high (3000–5999 MET-min/week) n = 107, and very high (>6000 MET-min/week) n = 95	Low = 218.5 ± 166.77 Moderate = 204.58 ± 169.16 High = 232.5 ± 206.77 Very high = 207.32 ± 197.47 p-value 0.71	Physical Activity did not show any association to sperm count
	Ibanez-Perez et al., 2019	150	Weightlifting, participants were divided into three groups according to intensity (0 h/week n = 83, ≤ 2 h/week n = 33, and >2 h/week) n = 34	0 h/week = 217.64 ± 166.82 ≤ 2h/week = 194.89 ± 151.34 >2 h/week = 146.79 ± 133.73 p-value 0.12	Weightlifting more than two hours per week was associated with a significant decrease in total sperm count
	Ibanez-Perez et al., 2019	174	Running, participants were divided into three groups according to intensity (0 h/week n = 93, ≤ 2 h/week n = 51, and >2 h/week) n = 30	0 h/week = 223.04 ± 161.90 ≤ 2h/week = 206.05 ± 152.12 >2 h/week = 178.69 ± 131.36 p-value 0.29	No significant association between running and sperm count
	Ibanez-Perez et al., 2019	154	Cycling, participants were divided into three groups according to intensity (0 h/week n = 83, ≤ 2 h/week n = 38, and >2 h/week) n = 33	0 h/week = 216.29 ± 168.05 ≤ 2h/week = 226.46 ± 160.68 >2 h/week = 181.21 ± 174.076 p-value 0.66	Cycling is associated with a decrease in sperm count with increasing dedicated time, although results did not reach statistical significance
	Ibanez-Perez et al., 2019	107	Tennis/Padel, participants were divided into three groups according to intensity (0 h/week n = 82, ≤ 2 h/week n = 16 and >2 h/week) n = 9	0 h/week = 221.05 ± 166.16 ≤ 2h/week = 182.87 ± 120.0 >2 h/week = 295.62 ± 143.52 p-value 0.31	No significant association between tennis/padel and sperm count
11	Bagatell and Bremner., 1990	12	Participants are subject to run a weekly mileage of 40 miles	Runners = 119.9 ± 64.4 Control = 108.9 ± 91.7	No significant difference in sperm count between exercising and sedentary man
12	Jensen et al., 1995	24	Participants are enrolled in a training program designed to prepare for a 56 km marathon 5 months after the study. Training consisted of a weekly run increasing in intensity before the marathon and decreasing gradually after. Participants ran an average of 46 km/wk in december, 65 km/wk in february, 78 km/wk in april, 60 km/wk in june, 43 km/wk in august, and 39 km/wk in october	No exact number was included in the published article	No difference in the mean sperm count was demonstrated over this year-long study

	Study	n	Exercise (FITT)	Sperm count (mln/ejaculate)	Summary
	Jensen et al., 1995	151	Participants are enrolled in a training program designed to prepare for a 56 km marathon 5 months after the study. Training consisted of a weekly run increasing in intensity before the marathon and decreasing gradually after. For analysis, training programs were divided into high (>60 km/wk, n = 78) and low (<55 km/wk, n = 73) training groups	High = 133 ±141 Low = 71 ± 65 p-value 0.001	Significant differences in sperm counts were noted when the months of high training was compared with the months of low training
13	Shi et al., 2018	328	Participants were divided into 3 groups of sports frequency: very frequent (>2 /wk, n = 146), ordinary (>2 /month, n = 103), few (1 /month, n = 79)	No exact number was included in the article	Sports frequency is not significantly associated with sperm count
14	Sun et al., 2019	746	Participants were asked to fill an international physical activity questionnaire (IPAQ) to record physical activity for the past week, defined as MET-min/week analyzed in quartiles. Q1 n = 183, Q2 n = 189, Q3 n = 189, Q4 n = 185	Q1 = 152.1 (132.9, 171.3) Q2 = 150.4 (131.4, 169.4) Q3 = 145.3 (126.0, 164.6) Q4 = 157.5 (138.1, 176.9) p-value 0.39	No significant association between total physical activity and sperm count
	Sun et al., 2019	746	Participants were asked to fill an international physical activity questionnaire (IPAQ) to record the total time of moderate–to-vigorous activity in the past week. analyzed in quartiles. Q1 n = 194, Q2 n = 176, Q3 n = 197, Q4 n = 179	Q1 = 151.5 (132.5, 170.6) Q2 = 156.0 (137.0, 175.1) Q3 = 143.2 (123.8, 162.6) Q4 = 151.9 (132.3, 171.4) p-value 0.32	No significant association between moderate-to-vigorous exercise and sperm count
	Sun et al., 2019	746	Participants were asked to fill an international physical activity questionnaire (IPAQ) to record time spent in a sedentary activity for the past week, defined as MET-min/week analyzed in quartiles. Q1 n = 181, Q2 n = 178, Q3 n = 202, Q4 n = 185	Q1 = 151.0 (131.3, 170.7) Q2 = 159.1 (139.9, 178.3) Q3 = 146.4 (127.7, 165.1) Q4 = 149.0 (129.5, 168.5) p-value 0.32	No significant association between sedentary time and sperm count
15	Hall et al., 1999	8	Participants were subject to an 8 week training program. Preliminary VO2max measurement was done. The first 2 weeks was to establish a baseline (NT), the subsequent 2 weeks was spent training at a mean increase of 143% from NT. Weeks 5-6 training was done at a mean increase of 186% of NT. Training intensity in weeks 7-8 was reduced to 50% of NT.	No exact number was included in the published article	No significant treatment effect was observed for total sperm count

	Study	n	Exercise (FITT)	Sperm count (mln/ejaculate)	Summary
16	Safarinejad, Azma, and Kolahi, 2009	362	Participants were randomly assigned to moderate-intensity exercise (MIE; ~60% VO2max; group 1, n = 143) and high-intensity exercise (HIE; ~80% VO2max; group 2, n = 143) groups. The two groups exercised for 60 weeks in five sessions per week, each session lasting 120 min. The last 36 weeks consisted of the post-intervention phase during which the long-term effects of the intervention were assessed every 12 weeks, participants were exercising only at low intensity (~30% VO2max). In the end, 122 participants from the MIE and 124 participants from the HIE were analyzed	Baseline: HIE = 196 ± 32.6 MIE = 197 ± 32.4 p-value 0.358 Running phase: HIE = 106 ± 20.8 p-value 0.01 MIE = 161 ± 31.4 p-value 0.92 Recovery phase: HIE = 188 ± 31.2 p-value 0.03 MIE = 191 ± 30.4 p-value 0.72	There is a significant correlation between HIE, HIE duration, and sperm count
17	Lalinde-Acevedo et al., 2016	32	Participants were asked to fill a questionnaire on whether or not they routinely practice any physical activity. They were asked to fill the description, type, frequency, intensity, and duration if they did. This information was used to calculate the physical activities MET using the "Compendium of physical activities" as proposed by Ainswort et al. They were then divided into the physically active and sedentary groups.	Physically active = 353.6 (55.72-1080) Sedentary = 361.9 (100-997.4) p-value 0.82	No significant differences in either sperm concentration or morphology between physically active group and sedentary group

DISCUSSION

In this study, we reviewed some articles related to exercise intensity and its relation to sperm count on healthy male adults. From the table above there are several interesting findings that come across.

The Effect of Recreational Exercise in Healthy Male Adults' Sperm Count

Some of the results of our studies showed that, in healthy young men, regular physical activity improves sperm count. In the research of healthy males of 19 years and above that has been separated into two groups which are physically active (PA, 16 subjects) and sedentary (SE, n = 15), the results of sperm count has been showed that physically active = 3.24 (±0.81) and sedentary = 3.19 (±0.74) [3]. This demonstrates that, when compared to not exercising at all, moderate exercise may create a more conducive setting for the processes involved in sperm development [3]. On the other hand, a higher level of physical activity was found to be associated with a higher sperm count in a survey of men ranging in age from 20 to 55 years old who were healthy and who had been surveyed of the average duration (in minutes) and frequency (days) they spent on four PA domains (work-related, transport-related, domestic and gardening (yard), and leisure time) during the week prior to an appointment [4]. This analysis supports the theory that compared to men who are less active, regular physically active males have improved hormone levels and sperm production [5].

The Effect of Intense Exercise in Healthy Male Adults' Sperm Count

According to the findings of the previous research, exercise levels ranging from moderate to vigorous were reported to have a considerable connection with total sperm count levels that were greater [6]. However, the findings of recent research indicate that prolonged and strenuous physical activity can lower both the quality and quantity of sperm [7]. Because lower testosterone levels lead to a lower sperm count, men should avoid strenuous exercise for extended periods of time [8]. Men who lifted weights for more than two hours each week saw a significant decrease in their total sperm count [7]. There is evidence that can be found in the sperm samples of weightlifter participants that were acquired through masturbation after a time of abstinence ranging from three to five days. The findings demonstrated that the sperm count dropped significantly as the length of time required to do the weightlifting tasks increased [7].

The Comparison Between Physical Activity and Intense Exercise Groups Sperm Count

The findings may indicate that the group who participated in strenuous exercise had a greater number of sperm than the group that participated in physical activity [4]. This can be seen when there are significant differences in sperm counts that were noted when the months of high training were compared with the months of low training, and higher physical activity (PA) was related to higher sperm count [4]. In addition, significant differences in sperm counts were noted when the months of high training were compared with the months of low training [4]. However, additional findings from related studies suggest that a more reasonable explanation is that the sperm count of people who participate in extreme activity is lower than the sperm count of people who participate in less intense exercise [8]. This can be determined if the number of sperm produced by weightlifters is lower than the number produced by runners [8].

These results build on existing evidence that suggests males who participate in activities such as bodybuilding, wrestling, and track and field athletics, amongst others, have a higher risk of having low sperm counts [8].

The Comparison Between the Sperm Quantity Between Healthy Male and Athletes

The comparison between healthy males and athletes indicates a different finding in sperm quantity. Six out of seventeen studies which were assessed showed that healthy adult males aged 18 years and above who do exercise give positive effects on sperm count [7][8][9][10][11][12]. Overall sperm count was substantially correlated with moderate exercise [3]. This phenomenon may occur because higher exercise intensities are necessary to stimulate antioxidant enzymes and defense mechanisms [3]. Inducing antioxidant enzymes is linked to the activation of NF-B and mitogen-activated protein kinase [3]. These variables have long been known to play a role in spermatogenesis, germline apoptosis, and the motility and fertility of sperm [3]. In addition to the general health improvement and the enhanced conditions for seed development and maintenance, this pathway appears to be responsible for both [3].

Nevertheless, essentially little influence on sperm quantity was seen in studies in which male athletes participated in workout programs at specific times [13]. Although one study found no correlation between the quantity and quality of athletes' sperm, it did find differences in sperm composition [14]. An increase in immature spermatozoids and round cells in the semen ejaculate of runners, as well as a decrease in the amount of normal and motile spermatozoids, are all indications that running may influence semen characteristics [8]. While some research has identified a correlation between athletic performance and lower steroid levels in the testicles, other studies have found no influence on sperm count overall [6][7][9][11][13][14][16][17][18]. It is worth mentioning that even though testosterone levels have dropped, they are still within the low normal range, and are not likely to have any effect on sperm production [15]. Further studies are required to explain this phenomenon.

The Comparison of Study that indicates Physical Activities Are Related and Not Related to Sperm Quantity

There are studies that link exercise intensity to increased sperm count, and there are other studies that find no connection between exercise and sperm count. According to the results of numerous scientific studies, engaging in physical activity has a direct and beneficial effect on sperm count [3][4][5][6]. All these investigations were conducted on people over the age of 18. While one study suggests that weightlifting and cycling may reduce an adult male's sperm count, this finding was not statistically significant [7]. This is because the number of sperm is correlated with how strenuously one exercises [4][8]. Moderate intensity exercise was found to be the most effective in enhancing male reproductive health markers [6].

The study that found no significant difference in sperm quantity between exercise intensity, explained that exercisers have a normal sperm quantity but decreased testicular steroid hormone, which has no clinical effects on daily situations [7][13]. It was speculated that reducing steroidal hormones would have little to no effect on sperm production, or that there would be a different regulation mechanism for gametogenesis and steroidogenesis [13]. Exercise may also increase the production of steroid hormones and sperm, although this is not yet known and will require future longitudinal research to determine [13].

CONCLUSIONS

From several reviewed journals, it said that exercise and physical activity provide benefits to sperm count. Moderate intensity exercise was found to be the most effective in improving markers of sperm count. Meanwhile, there are journals that contradict that there is no significant difference between exercise and sperm count. There is a speculation that the reduction in steroid hormones will have little or no effect on sperm production, or that there will be different regulatory mechanisms for gametogenesis and steroidogenesis. In conclusion, physical activity on sedentary adult males has shown a positive effect on the sperm count. However, athletes showed no significant decrease in sperm count. Therefore, further studies are needed.

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