Associations between physical activity and semen quality in young healthy men

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Objective: To evaluate whether the level of everyday physical activity is associated with semen quality in young men.
Design: Cross-sectional study.
Setting: Universities, clubs, and societies.
Patient(s): Young healthy men (aged 18–35 years) with unknown fertility (n = 177).
Interventions(s): Collection of data on medical history, lifestyle factors (physical activity, nutrition, addictions), and environmental threats (exposure of gonads to cellular phones, laptops). Collection of semen samples.
Main Outcome Measure(s): Semen parameters.
Result(s): Men who were physically more active (3rd and 4th quartiles) had a higher percentage of immotile sperm than less active subjects (1st and 2nd quartiles). The mean (95% confidence interval) percentages were, respectively: 53% (38%–69%) and 51% (41%–61%) versus 38% (28%–49%) and 39% (29%–48%). Other semen parameters were unrelated to physical effort.
Conclusion(s): Physical activity might be associated with an altered percentage of immotile sperm in young, lean, educated men who have not fathered children. (Fertil Steril® 2017;107:373–8. ©2016 by American Society for Reproductive Medicine.)
Key Words: Semen quality parameters, semen analysis, physical activity

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Physical activity is an established means to maintain fitness and health. Physicians commonly recommend "more exercise" as an integral part of therapy in a range of health conditions. Multiple benefits of exercise have been shown for individuals of different ages, genders, and body statuses (1).

Although there has been expanding knowledge on the cardiovascular, oncologic, and psychologic effects of an active lifestyle, the same progress has not occurred in understanding the association between physical effort and reproduction (2, 3). In consideration of a worldwide problem of male factor infertility, there are reasons to ask about the links between exercise and male reproductive health (4).

The available information on the relationship between physical activity and semen quality is often ambiguous. Some authors have found associations between physical activity and semen parameters (5, 6) whereas others have not (7, 8). It may be supposed that professional sport poses specific threats in this regard. Conclusions are hindered because of other lifestyle variables (diet, addictions), the environment (pollution, toxins), and chronic conditions (medications). Certain types of training (cycling), the intensity of exercise (intense vs. moderate), and type of underwear (tight vs. loose) specifically interfere with the results. Working with laptops or carrying cellular phones might also have some impact on the male gonads.

The fact that not only professional but also recreational athletes widely use hormonal doping makes investigations in this field even more difficult. A range of commonly used, albeit illegal, substances interfere with the hypothalamus-pituitary-gonadal axis (e.g., anabolic-androgenic steroids, gonadotropins) (9, 10).

It is important to consider geographic patterns or gradients in sperm quality (11, 12). Moreover, when comparing past and present andrologic data, it is necessary to consider a secular trend in sperm counts (13, 14) and changes in semen analysis techniques over time (15, 16).

Our aim was to evaluate whether the level of everyday physical activity is associated with semen parameters

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in young healthy men. For many reasons (personal, cultural, religious), this population is rarely screened. We wanted to omit the bias of recruitment of infertile or subfertile subjects whose semen profiles could be altered a priori. Unlike other protocols, we did not offer any financial incentives to the participants. Knowledge on the possible effects of exercise on semen quality should be of value to anyone interested in human reproduction.

MATERIALS AND METHODS

The aim of this project, entitled "Andrologic Status of Young Men in Lower Silesia" (AndroLS), was to evaluate the associations between a range of lifestyle factors (physical activity, diet, addictions) and the seminologic/hormonal profiles of young men with unkown fecundity.

This project was approved by the local Bioethics Committee (no. 36/2.12.2013). We obtained written informed consents from all subjects before their participation. The procedures were conducted in compliance with the Declaration of Helsinki for human subjects and the European Communities Council Directive of 24 November 1986 (86/609/EEC).

We addressed our invitations to young (aged 18–35 years) healthy men who were inhabitants of Lower Silesia, Poland. The region of Lower Silesia has a population of nearly 3 million people and belongs to one of the most industrialized parts of the country.

We contacted potential participants through personal communication and fliers at major regional universities, invitations to societies/clubs, and messages sent via social media. We directly addressed ~5,000 men. The eligibility criteria were: an absence of any known andrologic pathology (past and present), such as hypogonadotropic or hypergonadotropic hypogonadism; an absence of urogenital surgery; an absence of chronic conditions; and an absence of substances that might interfere with laboratory evaluations.

The initial 500 enrollees were asked to complete questionnaires covering their medical history, nutritional habits (7-day recall diary), and physical activity (IPAQ; past 7-day recall) (17). The enrollees were surveyed on the number of hours spent weekly resting a laptop on their knees, carrying a cellular phone in their pants pockets, and sitting in a sauna. The data collection was supervised by the researchers. We asked each participant to wear a pedometer for a week (Omron HJ-203-EK) to cross-check the data from the questionnaires.

In the next step, the participants were asked to donate blood (after fasting, before 9:00 a.m.) and sperm samples (after 2–7 days of sexual abstinence). The biologic material was acquired during appointed visits to the university-associated laboratories. We collected complete data from 177 subjects. The men who did not deliver semen or blood samples (n = 323) were excluded from the analyses. The entire study was performed in late autumn and winter. We counted the amount of physical activity as multiples of resting metabolic rate by minutes of performance during a week (MET-min/wk = MET Total). Participants reported on activities such as walking, moderate- and vigorous activity and sitting (separately for each type), their frequency (days per week), and duration (time per day). The total score was a sum of minutes and days of walking, with moderate-intensity and vigorous-intensity activity counted separately. According to the IPAQ criteria, the physical activity of a person who achieves $\geq$600 or $\geq$3,000 MET-min/wk is classified as moderate or high, respectively. Those who do not meet the above-mentioned criteria are classified as physically inactive (17).

Semen Analysis

The collection of semen for diagnostics and the semen analysis were consistent with the latest guidelines of the World Health Organization (WHO) (15).

The semen samples were collected in the andrology laboratory. The samples were obtained by means of masturbation, ejaculated into a sterile plastic (nontoxic for spermatozoa) container, and placed in an incubator (37°C) during liquefaction.

The ejaculation abstinence time (2–7 days) and the time between sample collection and analysis (30–60 minutes) were recorded in each participant's personal lab report.

All semen samples were analyzed with the use of the Sperm Class Analyzer (SCA; Casa System Microptic) by a single experienced medical analyst according to the WHO 2010 diagnostician laboratory manual. The performance of the laboratory is continually evaluated by means of an external quality assessment program (EQAS Labquality; www.labquality.fi).

The semen analysis included measurements of pH, viscosity, sperm count, sperm concentration, peroxidase-positive cells, and evaluations of the motility, vitality, and morphology of the sperm.

The semen volume was estimated by a weighing method (1 g of weight equals 1 mL of volume). The semen pH was measured with the use of pH indicator strips (Merck). The motility of spermatozoa was evaluated with the use of SCA. The procedure was performed at 37°C with a heated microscope stage. The sperm movement was graded as progressive motility, nonprogressive motility, and immotility. The number of spermatozoa was assessed with the use of SCA and verified manually with the use of the improved Neubauer hemocytometer (examination with phase-contrast optics at ×400 magnification). Eosin-nigrosin staining (Vitalscreen test; Fertipro) was used for the assessment of spermatozoa vitality. Each slide was examined with bright field optics at ×1,000 magnification and oil immersion. A Leucoscreen test (Fertipro) was applied to detect peroxidase-positive leucocytes with the use of the improved Neubauer chamber (evaluation with phase-contrast optics at ×400 magnification).

Sperm morphology was evaluated with the use of SCA and was verified manually (Diff-Quik staining method; Microptic). Examinations were performed with a bright-field objective at ×1,000 magnification and oil immersion. The following types of sperm were identified: normal sperm, pathologic forms, amorphous head sperm, round head sperm, tapered head sperm, double headed sperm, microcephalus

head sperm, macrocephalus head sperm, sperm heads with cytoplasmic droplets, vacuolated head sperm, abnormal midpiece sperm, and abnormal tail sperm.

Statistical Methods

The data were analyzed with the use of the Sigmaplot (Systat Software) statistics package, version 13, and the R environment (www.r-project.org). Continuous variables were first analyzed for normal distribution by means of the Kolmogorov-Smirnoff test with the Lilliefors correction. All semen parameters exhibited nonnormal distribution. We calculated Spearman rank correlation coefficient (rho) between studied variables (raw values) and semen parameters.

Continuous variables (such as MET Total, body mass index [BMI], alcohol intake (derived from the equation: 0.05 beer + 0.13 wine + 0.4 [vodka + whisky]), carrying cellular phone in pant pockets, caffeine intake) were analyzed in quartiles. Consecutive quartiles were treated as a quality variable to evaluate relationships other than linear. Nonparametric methods were chosen to compare distributions between quartiles given to lifestyles (physical activity), i.e., Kruskal-Wallis test of variance. We calculated medians and 95% confidence intervals (CIs) for specific semen parameters (in each quartile and for all the observations). Linear regression was used to assess the association of physical activity with semen parameters after adjustments for potential confounders (i.e., factors related to semen quality in previously published studies: BMI, alcohol intake, smoking, wearing tight clothing, carrying cellular phone in pants pocket, working with a laptop on the knees, going to a sauna, caffeine consumption). To use linear regression we transformed the variables (to achieve normal distribution) in the following way: square roots of total sperm count, and sperm concentration, square of vitality. Caffeine consumption was changed into a quality variable: <25 mg/d (0) and ≥ 25 mg (1). Adjusted means and 95% CI for semen variables within each quartile were counted with use of the linear regression method either. The values of control variables were set at their medians (BMI: 23.8 kg/m^2; alcohol: yes; smoking: no; phone in pants pockets: yes; laptop: no; sauna: no; tight clothing: yes; caffeine: yes). Tests for linear trend were conducted with the use of the median values of MET Total in each quartile as a continuous variable and semen parameters as dependent variables.

Analysis of covariance models were created with continuous semen parameters as dependent and physical activity with adjustment for confounders as independent variables. Analysis of covariance was used to calculate adjusted semen parameters for each quartile by relevant covariates. Consecutive quartiles were treated as a quality variable to evaluate relations other than linear.

A P value $<.05$ was considered to be significant in all analyses.

RESULTS

The median age of the participants was 24.0 (95% CI 19.8–32.0) years, and their median BMI was 23.8 (20.0–29.2) kg/m^2. All of the studied men (n = 177) graduated from secondary schools. They had ≥ 12 years of education. Approximately 14% of the men smoked cigarettes, 90% drank alcohol (beer, wine, or spirits in the amount equivalent to ≥ 50 g of ethanol per week), and 19% used medications that did not interfere with the laboratory evaluation. A few men (4%) reported that their mothers smoked while being pregnant with them (Table 1).

TABLE 1

Characteristics of the study group (n = 177).

Variable	Result
Age, y	24 (19–32)
Body mass index, kg/m^2	24 (20–29)
Caffeine intake[a]	100
Current smokers	14
Alcohol drinking[b]	91
Sauna users	33
Laptop on the knees	42
Tight clothing	52
Telephone in pants pockets	94

Note: Results are presented as median (5th–95th percentiles) or %.
[a] Any amount of caffeine intake.
[b] Beer, wine, or spirits in the amount equivalent to ≥ 50 g ethanol per week.

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We found that 15% (n = 29) of the participants engaged in physical exercise regularly. The level of physical activity of our participants could be categorized as moderate or high in most of the cases (n = 169). In this subgroup, the median number of hours spent on moderate/intense exercise was 5.3 hours per week. The median number of hours spent sitting was 42 hours per week. Eight men did not reach the minimal amount of physical effort that is predicted to be beneficial for health. In the entire sample, the mean value of MET Total was 5,350 ± 4,627. This observation was confirmed by the mean number of steps (evaluated by pedometers), which was 8,152 ± 2,047 per day.

In the studied men, semen volume was (mean ± SD) 3 ± 1 mL, sperm concentration was 60 ± 44 × 10^6/mL, sperm count was 170 ± 137 × 10^6/ejaculate, progressive motility was 35 ± 14%, total motility (progressive + nonprogressive) was 54 ± 16%, and vitality was 60 ± 14%. The percentage of normal sperm was 15 ± 6%, and pathologic forms constituted 85 ± 9%. The most common abnormal form was amorphous head sperm, which was 55 ± 7%.

Our results suggest presence of a significant correlation (rho) between the level of physical activity and the percentage of immotile sperm (P=.017; Supplemental Table 1, available online at www.fertstert.org). This association was seen in an adjusted model (trend: P=.009; Table 2; Fig. 1). The adjusted means of percentages of immotile sperm (95% CI) were respectively 53% (38%–69%) and 51% (41%–61%) in the 3rd and 4th quartiles (higher level of physical activity) compared with 38% (28%–49%) and 39% (29%–48%) in the 1st and 2nd quartiles (lower levels of physical activity). Other semen variables were not related to physical activity (Table 2). We present relationships between the level of physical activity and the percentage of progressive motility sperm in Figure 2 and the percentage

TABLE 2

Associations between quartiles of physical activity and semen parameters (after adjustments).

Parameter	Q1 55–2,133 (n = 45)	Q2 2,205–4,068 (n = 43)	Q3 4,125–7,011 (n = 43)	Q4 7,038–32,388 (n = 44)	*P* value, trend	*P* value, ANCOVA
Semen volume (mL)	3 (2–4)	2.7 (1.9–3.4)	3.9 (2.8–5)	3.3 (2.4–4.2)	.739	.603
Sperm concentration ($\times 10^6$/mL)	49.5 (29.2–75)	45.3 (24.5–72.5)	48.2 (18.7–91.6)	49.6 (26.2–80.4)	.633	.562
Total sperm count ($\times 10^6$/ ejaculate)	132.9 (75.7–206.1)	105.8 (59.9–164.7)	198 (87.4–353.3)	121.9 (53.2–218.9)	.480	.794
Progressive motility (%)	42.5 (35.1–55.2)	32.1 (24–40.3)	31.7 (18.9–44.5)	34.8 (25.4–44.2)	.062	.308
Nonprogressive motility (%)	16.1 (12.2–19.9)	20.9 (16.5–25.2)	14.1 (8.4–19.9)	15.9 (11.9–19.8)	.962	.952
Immotile (%)	38.5 (27.7–49.4)	39 (29.5–48.5)	53.5 (38.1–68.9)	51.1 (40.8–61.5)	.009	.047
Vitality (%)	64.5 (55–72.8)	61.7 (53–69.4)	51.1 (33.7–63.9)	56.1 (46.4–64.4)	.059	.225

Note: Means and 95% confidence intervals are adjusted for BMI, caffeine, smoking, alcohol, sauna, laptop, tight clothing, and telephone in pants pocket. Tests for trend were conducted with the use of the median values of MET Total in each quartile. Analysis of covariance (ANCOVA) was used to calculate adjusted semen parameters for each quartile by relevant covariates.

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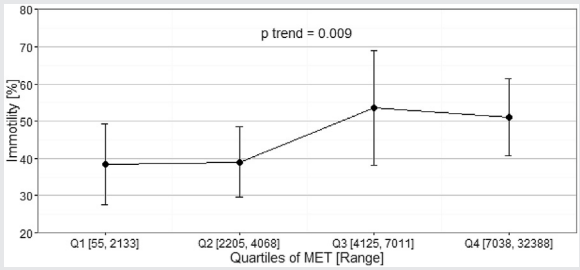
FIGURE 1



Associations between quartiles of physical activity and immotile sperm (see Table 2). Means and 95% confidence intervals are represented. Q = quartile; MET = metabolic equivalent of task.

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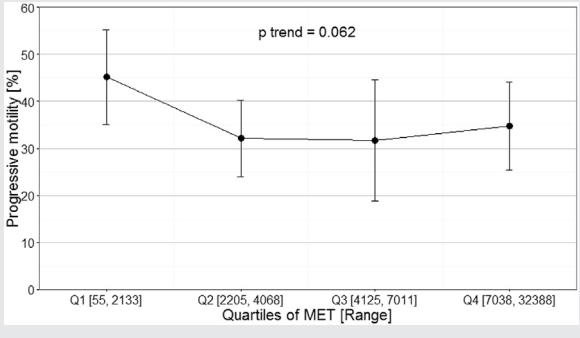
of vital sperm in Supplemental Figure 1 (available online at www.fertstert.org; in the model adjusted for BMI, alcohol intake, smoking, wearing tight clothing, carrying cellular phone in pants pocket, working with a laptop on the knees, going to a sauna, and caffeine consumption) because they were closest to statistical significance with *P* values for trends of, respectively, .062 and .059.

We observed no relationships between normal/abnormal sperm morphology (amorphous head sperm, round head sperm, tapered head sperm, double headed sperm, microcephalus head sperm, macrocephalus head sperm, sperm heads with cytoplasmic droplets, vacuolated head sperm, abnormal middle-piece sperm, abnormal tail sperm) and physical activity (data not presented).

DISCUSSION

Our data suggest that level of physical activity is associated with the number of immotile spermatozoa in young healthy men. Owing to the nature of this investigation, we can not imply any cause-effect relationship in this regard. Of note, we did not observe relationships between physical activity

FIGURE 2



Associations between quartiles of physical activity and progressive motility sperm (see Table 2). Means and 95% confidence intervals are represented. Abbreviations as in Figure 1.

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and the percentages of progressive and nonprogressive spermatozoa. We did not find any clear relationships between other semen variables, such as volume, viscosity, sperm concentration, sperm count, vitality, and morphology of the sperm, and physical activity, either.

We wanted to evaluate liaisons between physical activity and semen quality in healthy men with unknown fertility. Such relationships are especially difficult to investigate in subjects who have no reasons to seek medical counseling. Our rationale was that regular physical activity is among the key determinants of health. However, too much exercise might have deleterious effects on different body systems.

We used IPAQ for our investigation (17), because it is often forgotten that physical activity is not limited to voluntary exercise. In addition to participation in leisure sports, overall physical activity must consider domains such as occupation, transportation, and domestic chores (17). We acknowledge that none of the available methods used to evaluate physical activity is perfect (18).

Only 4.5% of our study subjects were physically inactive. Data from the pedometers confirmed this finding: Most participants moved >5,000 steps/day, which is above the recommended daily threshold of physical exercise. The lower-than-average (for the general population) percentage of inactive men in the sample could be explained by the relatively young age of participants or by their lack of interest in health assessments. On the other hand, there might be a tendency toward overestimation of physical activity with the use of a questionnaire.

The possible mechanisms through which physical activity and training might exert effects on sperm include oxidative stress, hormonal imbalances, increased scrotal temperature, and genital trauma (4). There is evidence that exercise increases the production of reactive oxygen species and reduces the concentration of antioxidants. Physically active men who are exposed to physical and psychologic stress might suffer from hypogonadism. Hypogonadism is even more probable in recreational or professional athletes using supplements and hormonal doping. The testes function well in temperatures lower than that of the core body. Specific sports (motor), tight clothing, or prolonged sitting might lead to alterations in spermatogenesis resulting from increased scrotal heat. Less is known about genital trauma; however, both acute and long-lasting consequences of training (microtrauma) on gonadal function have been reported (19, 20). Our analyses included variables such as alcohol consumption, smoking, carrying cellular phone in pants pocket, wearing tight clothing, working with a laptop on the knees, going to sauna, and consuming caffeine, because they were indicated as potential confounders in earlier studies.

The available data on associations between exercise and semen quality are ambiguous. In the case of sperm motility, a number of authors have suggested that exercise might be related to sperm motility (21–23). However, other authors did not confirm such hypotheses (5, 7, 8). We have not encountered information on associations between the percentage of immotile sperm (as a specific feature) and physical activity in the available literature. When our results are compared with the outcomes of other studies, one should consider, e.g., race and age differences, inclusion of subfertile/infertile subject, and geographic differences in semen profiles. In professional Spanish cyclists, a decreased sperm motility was observed during the competition period (23). In contrast, another small study showed that men who were physically active (n = 16) had higher progressive motility than sedentary control subjects (n = 15); unlike in our sample, the percentage of immotile sperm in physically active subjects was significantly lower than in sedentary men (31% vs. 35%; $P=.035$) (22).

The authors of one of the largest investigations conducted to date reported that sperm quality was generally not related to regular physical activity in 2,261 sperm donors from the United States. However, they noted that participants who bicycled ≥5 hours per week had decreased sperm motility (21). We have to stress that the described sample of that study differed considerably from ours. In that study, 26% of the studied subjects reported a history of male-factor infertility. The mean age and BMI of the Americans were, respectively, 36 years and 23 kg/m^2, compared with 25 years and 24 kg/m^2 in our subjects. The mean number of hours spent on moderate or vigorous activities in the Americans was higher than in the men studied by us (8.25 vs. 5.3 h/wk, respectively).

In turn, the results of the Rochester Young Men's Study performed on 189 young men (university students) aged 18–22 years showed that sperm motility (total or progressive), sperm morphology, and semen volume were unrelated to physical activity. There was also no correlation between the time spent watching television and sperm motility (5). Similar results were obtained in a cross-sectional study of students from the Murcia Region, Spain (7). Among 215 healthy men with untested fertility (mean age 20 years, mean BMI 24 kg/m^2), there was no association between physical activity and semen parameters (7). The prevalence of smoking in that group was higher (24% vs. 68%) and the consumption of caffeine lower (76 vs. 91 mg/d) than in our subjects. The median number of hours spent on moderate or vigorous physical activities by the Spaniards (5 h/wk) was similar to that observed in our subjects (5.3 h/wk). In contrast to our findings, the authors of the Spanish study excluded significant undesirable effects of physical activity on sperm.

Earlier studies have suggested that moderate and vigorous physical activity might be correlated with sperm count and sperm concentration (5). Interestingly, physical activity and watching television were not closely correlated in this regard. It remains to be clarified whether the effects of low physical activity are mediated by a lack of exercise or by, for example, obesity or longer hours spent sitting with an elevated scrotal temperature. In our sample, physical activity was related neither to sperm count nor to sperm concentration.

High caffeine intake might be associated with a decreased sperm count and concentration (24), and some authors observed better sperm motility in men who drank more coffee (25, 26). In our study, there were no significant relationships between caffeine intake and sperm variables.

The strength of the present study is that it was performed in healthy young subjects who had no known fertility issues,

were before family-starting age, and did not suffer from any other chronic conditions.

Unlike other investigations, we avoided the bias of recruitment through infertility clinics or andrology units. In contrast to many other projects, we did not offer financial incentives to the participants. The subjects had to be attracted to the study by pure interest in their own andrologic and nutritional status. We used a physical activity questionnaire that represents all aspects of physical activity and was previously validated and used in our environment.

The population of Lower Silesia is close to 100% white, which should have eliminated potential genetic differences within the sample. On the other hand, the sample is not representative for the worldwide population.

Among the limitations of the present study is the low percentage of subjects whose level of physical activity was under the threshold to affect health. We should notice, however, that the studied men were young, educated, and living in urban environments, which usually correlate with higher physical activity level (27). We assume that less active subjects might also be less willing to engage in research projects. Because of objective limitations, we were not able to exclude chromosome Y microdeletions that are known to affect the quality of sperm. A shortcoming is that only one sample per subject was collected.

The mean age of the studied men was higher than in other recently described cohorts (5, 7), which should be acknowledged when the data are to be compared. We look forward to possibilities for widening our research to men of different educational levels, living environments (urban vs. rural), or dietary patterns.

CONCLUSION

In young healthy men, physical activity seems to be related to the percentage of immotile spermatozoa. A higher level of physical activity might be associated with a higher percentage of immotile sperm. Other semen parameters (semen volume, sperm concentration and count, progressive and nonprogressive motility, vitality, and sperm morphology) were not related to physical activity.

Our observation applies to a lean, educated, and physically active population. Whether this observation is also true for young men of different body masses, educational statuses, and exposures to cigarettes or alcohol requires further investigation.

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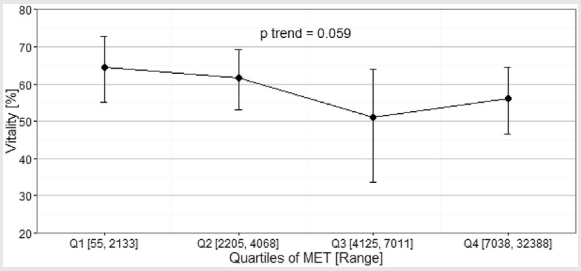
SUPPLEMENTAL FIGURE 1



Associations between quartiles of physical activity and vital sperm (see Table 2). Means and 95% confidence intervals are represented. Abbreviations as in Figure 1.

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SUPPLEMENTAL TABLE 1

Associations between quartiles of physical activity and semen parameters.

Parameter	All	Q1 55–2,133 (n = 45)	Q2 2,205–4,068 (n = 43)	Q3 4,125–7,011 (n = 43)	Q4 7,038–32,388 (n = 44)	P_1 value	rho	P_2 value
Semen volume (mL)	2.8 (2.6–3.0)	2.8 (2.2–3.1)	2.7 (2.2–3.0)	3.0 (2.5–3.3)	2.8 (2.6–3.2)	.591	0.05 (−0.10 to 0.20)	.509
Sperm concentration ($\times 10^6$/mL)	50.3 (46.1–59.9)	52.3 (45.8–71.2)	42.0 (24.8–49.0)	39.8 (18.8–49.1)	52.2 (30.0–64.4)	.585	0.01 (−0.14 to 0.16)	.912
Total sperm count ($\times 10^6$/ejaculate)	141.3 (123.1–165.7)	138.2 (101.9–165.6)	146.9 (124.1–197.3)	133.8 (100.4–167.3)	148.0 (100.4–220.8)	.984	−0.01 (−0.16 to 0.13)	.845
Progressive motility (%)	36.0 (33.0–44.0)	38.5 (31.0–46.0)	37.0 (31.0–42.0)	37.0 (33.0–49.0)	31.0 (25.0–34.0)	.207	−0.15 (−0.29 to 0.00)	.048
Nonprogressive motility (%)	18.0 (17.0–19.0)	18.0 (17.0–21.0)	19.0 (18.0–20.0)	18.0 (15.0–22.0)	17.0 (14.5–19.0)	.817	−0.02 (−0.17 to 0.13)	.757
Immotile (%)	44.0 (42.0–48.0)	37.5 (28.0–41.0)	42.0 (38.0–48.0)	43.0 (35.0–50.0)	51.5 (45.5–58.5)	.063	0.18 (0.03–0.32)	.017
Vitality (%)	61.0 (57.5–62.5)	64.5 (58.0–71.0)	62.0 (52.0–65.0)	62.0 (55.0–69.0)	59.0 (57.0–64.0)	.253	−0.13 (−0.27 to 0.02)	.099

Note: Physical activity (MET Total) analyzed in quartiles with medians and bootstrap 95% confidence intervals for specific semen parameters (in each quartile and for all the observations). P_1 values refer to Kruskal-Wallis test. Spearman rank correlation coefficient (rho) are presented with 95% confidence intervals, and P_2 values test the significance for rho.

Jóźków. Physical activity and semen quality. Fertil Steril 2016.