Semen quality among young healthy men taking protein supplements

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Objective: To study the association between use of protein supplements (PS) and semen quality among young men.
Design: Cross-sectional study.
Setting: Not applicable
Patient(s): We used data from the Fetal Programming of Semen Quality (FEPOS) cohort, which is a subsample of 778 men whose mothers enrolled in the Danish National Birth Cohort 1996–2002.
Intervention(s): Semen samples were collected from April 2017 to March 2019. Relative difference in semen characteristics according to self-reported PS use was estimated with negative binomial regression adjusting for lifestyle factors including exercise, body mass index, and use of anabolic steroids, and maternal and paternal factors potentially confounding the association between PS and semen quality.
Main Outcome Measure(s): Negative binomial regression yielded the best fit and was used to estimate the percent difference with 95% confidence intervals in semen volume, sperm concentration, total sperm count, proportions of progressive, nonprogressive, and immotile sperm, and percentage of morphologically normal sperm in former and current users of PS relative to never users.
Result(s): PS was used currently by 28% and formerly by 24% of participants. PS use was not associated with reduced semen quality in terms of semen volume, sperm concentration, total sperm count, morphology, or motility in either crude or adjusted analyses.
Conclusion: This study showed no association between use of PS and semen quality characteristics. Still, we encourage others to repeat the study, as even a small harmful effect would have a large impact on the population level because of the widespread use of PS among young men. (Fertil Steril® 2020;114:89-96. ©2020 by American Society for Reproductive Medicine.)
El resumen está disponible en Español al final del artículo.

Key Words: Sperm count, sports nutrition products, creatine, training, reproductive health

The sale of sports nutrition products is growing worldwide. The rise is driven especially by increased consumption outside the group of elite athletes for whom they were originally intended (1). Especially among male commercial gym-goers, the use of protein supplements (PS) is high, with reports from 24% in Beirut, Lebanon, to 48% in Mainz, Germany (2–5). According to a newly published report by the Danish National Food Institute, 16% of all Danes aged 15–55 years reported having used sports nutrition products during the previous month (6), with the highest prevalence of users observed among men. Hence, 71% and 57% of the males aged 15–34 and 35–55 years, respectively, reported having used protein PS, creatine, or amino acids alone or in combination (6). Parallel to the increasing popularity of PS, multiple reports have surfaced about them containing undeclared contaminants and banned substances including anabolic–androgenic steroids (7–9). Anabolic–androgenic steroids have been shown to increase risk of hypogonadotropic hypogonadism (10), which has been linked to poor semen quality (11). Increasing intake of isoflavones with high estrogenic activity among men using soy-based PS has also raised concern, although evidence regarding

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their effects on semen quality is conflicting (12–14). To our knowledge, only one published study has examined the association between PS and semen quality. In that study, Ketheeswaran et al. reported more than a doubling in median semen concentration and total sperm count among 20 subfertile men after abstaining from PS for a median of 4.5 months (15). However, this study was based on a small and selected population, had no control group, and did not take into account other potential lifestyle changes during the abstinence period. We therefore studied the association between use of PS and semen quality among 778 unselected young men, taking into account concurrent health behavior and fetal risk factors.

MATERIALS AND METHODS

Study Population

We used data from the Fetal Programming of Semen Quality (FEPOS) cohort, a subcohort of young adult sons born to women enrolled in the Danish National Birth Cohort (DNBC) in connection with their pregnancy in 1996–2002 (16). From April 2017 to March 2019, the sons were invited to complete a comprehensive questionnaire on lifestyle, health, and physical activity, including use of PS, to undergo a clinical examination, and to provide a semen sample. The clinical examination was performed at either the Department of Occupational and Environmental Medicine at Bispebjerg Hospital in Copenhagen or at the Department of Occupational Medicine at Aarhus University Hospital in Aarhus. To be included, the sons had to be at least 18 years 9 months of age, to live near Copenhagen or Aarhus, to have both testicles in the scrotum, and to have not undergone sterilization or chemotherapy. Of the 4,254 invited sons, 778 (18%) participated.

Protein Supplement (Exposure)

PS use was obtained from an online questionnaire before the clinical examination. Participants were asked, "Do you use, or have you used, energy supplements such as creatine or protein supplements in the form of, for example, powder or bars?" with the reply options "No, never," "Yes, within the last 3 months," and "Yes, but more than 3 months ago." Current and former users were then asked about frequency of use: "1–3 times per month," "1–3 times per week," or "at least 4 times per week." From the FEPOS questionnaire, we obtained information on type of supplement taken (creatine only; protein supplement only; creatine and protein supplements combined), frequency of current or former use (1–3 times per month; 1–3 times per week; $\geq$4 times per week).

Semen Quality Characteristics (Outcome)

Semen samples were produced at the clinic or at the participant's home. In either case, the participant was provided a sample cup and detailed instructions on being sexually abstinent 48–72 hours before sample collection, and on delivery of the sample and its transportation. Spillage, if any, and time of abstinence were recorded. Semen samples were analyzed by two trained biomedical laboratory technologists affiliated with the clinic in Copenhagen and Aarhus, respectively. The technologists were blinded to the exposure status of the sons. The FEPOS technologists participated in an ongoing quality control program with the Centre of Reproductive Medicine in Malmö, where they also trained in analyses ensuring compliance with recommendations of the World Health Organization before data collection. In January 2018, their average interobserver coefficient of variation (CV) was 18.4% (10.1%–31.4%) for sperm concentration and 12.7% (2.0%–26.0%) for sperm motility, based on five samples. This is similar to or less than the CV of trained technologists of the reference laboratory analyzing the same samples. The ESHRE External Quality Assessment scheme (Centre for Andrology, Karolinska University Hospital, Stockholm, Sweden) was also followed. The average Z-scores based on the average of four samples in each of three assessments (winter 2017, spring 2018, and winter 2018) compared to expert reference examiners were −0.04 for concentration, −0.60 for motilite sperm, and 0.27 for all progressive sperm. These results were comparable to previous studies and well below the $\pm$3, that is considered acceptable for semen quality measures (17). All semen analyses (semen volume, total sperm count, sperm concentration, sperm motility, and sperm morphology) followed the World Health Organization 2010 recommendations (18). Time from delivery of the semen sample to its analysis was recorded. Semen volume was measured by weighing the sample in a pre-weighed vessel. The sample was then placed in a 37 °C incubator for liquefaction. Sperm concentration was determined on two aliquots of diluted semen samples using an Improved Neubauer Hemocytometer. Sperm cell motility was determined by counting the proportions of [1] progressive sperm; [2] nonprogressive sperm; and [3] immotile sperm, on 200 spermatozoa within each of two fresh drops of semen, placed on a preheated (37°C) clean glass slide with a cover slip. Morphology (percentage of normal sperm) were analyzed at the Centre of Reproductive Medicine in Malmö.

Covariates

A self-reported questionnaire was used to obtain the following: primary motivation for using PS (building muscle; weight gain; endurance; weight loss; other), weekly exercise (never; 1–3 times, $\geq$4 times), use of anabolic steroids (never; current; former), tobacco smoking (never; former and occasional smokers; daily and weekly smokers), e-cigarette habits (never, experimental, and former vapers; occasional vaper; daily vapers), alcohol intake (never and former drinkers; less than once a week; 1–2 times a week; $\geq$3 times a week), and ever use of marijuana, ecstasy, and cocaine (never used; ever used). Body mass index (BMI; kg/m^2) and proportions of fat, muscle, and bone mass were measured at the clinical examination using a MC-780MA Body Composition

Analyzer (Tanita, Tokyo, Japan). Regarding the semen sample, any spillage and abstinence time in days were recorded by the participant in a form accompanying the sample cup. Season of sample delivery was derived from the examination date (Winter: December–February; Spring: March–May; Summer: June–August; and Fall: September–November).

History of congenital malformations was obtained from the Danish National Patient register, which holds information on all public or private hospital admissions and outpatient visits, and included cryptorchidism (International Classification of Disease-Tenth Revision [ICD-10]: Q53), hypospadias (ICD-10: Q54), and other congenital malformations (ICD-10 codes Q55–Q56) as well as urogenital disorders including hydroceles (ICD-10: N43), testis torsion (ICD-10: N44), phimosis (ICD-10: N47), and varicocele (ICD-10: I86) (19). To also capture congenital and urogenital disorders not recorded at the hospitals, self-report cases were added.

Information on risk factors occurring during the sons' fetal life and potentially linked to their use of protein and to their semen quality was obtained from a computer-assisted telephone interview of the expectant mothers conducted around pregnancy week 16. This included information on maternal pre-pregnancy BMI, average weekly alcohol consumption (none; <1; 1–3), smoking during the first trimester (no; yes), and paternal smoking as reported by the mother (no; yes). Household occupational status at the time of pregnancy was based on DISCO-88 and the Danish International Standard Classification of Education using the highest value of self-reported maternal and paternal occupation (high-grade professional; low-grade professional; skilled and unskilled worker; student and economically inactive). Parental ages at conception were obtained from the Medical Birth Registry (20).

Statistical Analyses

We first calculated medians and 25th and 75th percentiles of semen quality characteristics (semen volume, total sperm count, sperm concentration, sperm motility, and sperm morphology) according to use of PS. Residuals from standard linear regressions with and without log-transformed outcomes violated the normal distribution assumption. Negative binomial regression yielded the best fit and was used to estimate the percent difference in semen quality characteristics in former and current PS users relative to never users. Analyses of total sperm count and semen volume were restricted to persons reporting no spillage of the semen sample. Analyses were adjusted for fetal risk factors including parental smoking, occupational status, and ages at conception, maternal pre-pregnancy BMI and alcohol consumption, the sons' congenital and urogenital malformations, and the sons' concurrent risk factors including their use of tobacco, e-cigarettes, marijuana, ecstasy, and cocaine, BMI, relative tissue composition (fat, bone, and muscle), consumption of alcohol, and exercise, and finally precision variables correlated with semen parameters, including sexual abstinence time, clinic of analysis, place of ejaculation, and season. Analyses of motility were also adjusted for number of minutes from sample collection to analysis (for analyses with motility outcomes). All analyses were performed using STATA-14 (StataCorp, College Station, TX).

Compliance With Ethical Standards

Informed consent was obtained from all individual participants included in the study. The establishment of the FEPOS cohort was approved by the Scientific Research Ethics Committee for Copenhagen and Frederiksberg (No. H-16015857) and the Danish Data Protection Agency (No. 2012-58-0004). Moreover, recruitment and data collection were permitted by the Steering Committee of the DNBC (Ref. no. 2016-08).

RESULTS

A total of 778 sons participated in the study. Four sons were excluded because of missing information on PS use and four others for not providing a semen sample. Baseline characteristics according to use of PS of the remaining 770 sons are presented in Table 1. PS was used currently by 28% and formerly by 24%. The majority (57%) of the current and former users reported use of PS only, whereas 26% used a combination of protein and creatine. Users were motivated primarily by the building of muscle. One current and three former users reported having used anabolic steroids. Current PS users exercised more frequently, with 55% exercising at least four times per week compared with 16% among never users. The proportion of normal BMI individuals did not differ across PS use, but there were more individuals with high BMI among current than among never users. More current users had a history of congenital and urogenital malformations than never users. Fetal risk factors were similar among current and never users of PS, except that a higher proportion of current users had been exposed to maternal smoking (Table 2). Furthermore, current users parents had a generally higher occupational status. Semen quality characteristics are presented in Table 3, overall and according to PS use. In total, 80% of the semen analyses were initiated within 1 hour of delivery, and 99% within 1 hour 55 minutes. Median semen volume, motility, and morphology were similar across PS use. Semen concentration and total sperm count were higher in current users than in never users, but we observed no statistically significant association between PS use and any of the semen characteristics (Table 4). Exclusion rather than adjustment for the 126 sons with a history of congenital malformations and/or urogenital problems did not alter results.

DISCUSSION

In this cross-sectional study of 778 young men, we found a high proportion of former and current users of PS. This is higher than reports from commercial gym-goers (2–5). Because of several international reports of contamination of protein products potentially toxic to reproduction (7–11) and because of concern regarding high intake of estrogenic isoflavones from soy-based supplements relative to male reproduction, we had hypothesized a lower semen quality among current and former users compared to never users, but found no evidence of such an association.

Our findings contrast with those of Ketheeswaran et al., who observed more than a doubling in median sperm concentration and total sperm count in subfertile men attending fertility treatment, who were asked to stop using supplements

TABLE 1

Characteristics of 770 included sons according to use of protein and creatine supplements.

Characteristic	All n = 770	Never users n = 366 (48%)	Former users n = 187 (24%)	Current users n = 217 (28%)
Weekly training				
Never	126 (16)	100 (27)	19 (10)	7 (3)
1–3 times/wk	407 (53)	209 (57)	108 (58)	90 (41)
≥4 times/wk	237 (31)	57 (16)	60 (32)	120 (55)
Body mass index (kg/m^2) mean (SD)	23 (4)	22 (4)	23 (4)	22 (3)
Underweight	63 (8)	40 (11)	10 (5)	13 (6)
Normal weight	561 (73)	259 (71)	137 (73)	165 (76)
Overweight	128 (17)	57 (16)	34 (18)	37 (17)
Obese	16 (2)	9 (2)	6 (3)	1 (0)
Fat mass %, mean (SD)	15 (4)	15 (6)	15 (5)	14 (5)
Muscle mass %, mean (SD)	81 (5)	81 (6)	81 (6)	85 (5)
Bone mass %, mean (SD)	4 (0)	4 (0)	4 (0)	4 (0)
Tobacco smoking				
Never smokers	365 (47)	187 (51)	78 (42)	100 (46)
Former and occasional smokers	207 (27)	88 (24)	54 (29)	65 (30)
Daily and weekly smokers	198 (26)	91 (25)	55 (29)	52 (24)
E-cigarette smoking				
Never, experimental, former	709 (92)	342 (93)	169 (90)	198 (91)
Occasional vapers	38 (5)	15 (4)	12 (6)	11 (5)
Daily vapers	23 (3)	9 (2)	6 (3)	8 (4)
Frequency of alcohol consumption				
Never/former drinkers	54 (7)	33 (9)	7 (4)	14 (6)
Less than once/wk	318 (41)	139 (38)	82 (44)	97 (45)
1–2 times/wk	348 (45)	171 (47)	83 (44)	94 (43)
≥3 times/wk	50 (6)	23 (6)	15 (8)	12 (6)
Ever users of marijuana	528 (69)	229 (63)	146 (78)	153 (71)
Ever users of ecstasy	144 (19)	60 (16)	36 (19)	48 (22)
Ever users of cocaine	171 (22)	74 (20)	48 (26)	49 (23)
Congenital malformations	50 (6)	18 (5)	11 (6)	21 (10)
Urogenital problems[a]	123 (16)	53 (14)	35 (19)	35 (16)
Anabolic steroids			2 (1)	1 (0)
Type of supplement				
Creatine			42 (22)	27 (12)
Protein			108 (58)	121 (56)
Creatine–protein combination			37 (20)	69 (32)
Motivation				
Build muscle			147(79)	156 (72)
Weight gain			15 (8)	22 (10)
Endurance			19 (10)	18 (8)
Weight loss			2 (1)	4 (2)
Other			4 (2)	17 (8)
Frequency of use				
1–3 times/mo			60 (32)	74 (34)
1–3 times/wk			80 (43)	92 (42)
≥4times/wk			47 (25)	51 (24)

Note: Values are presented as n (%), unless specified otherwise. SD = standard deviation.

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(15). However, that study was based on a small sample of only 20 men and had no control group, and therefore no way of assessing whether the findings were merely a matter of regression toward the mean. This is relevant to consider, as extreme measurements within the same individual tend to approach average values when analyzing repeated semen samples. It is also possible that the subfertile men assessed in their cohort were more vulnerable to PS or potential contaminants in PS than young healthy men. It is also possible that the men in our sample used PS with no or only trace levels of contaminants or in such low quantities that the doses were too low to be harmful. Denmark follows regulation (EU) no. 1169/2011 of the European Parliament and European Council whereby sports nutrition products including protein supplements since July 20, 2016, have been regulated as foods (21). According to these regulations, the supplements should display information about what the product contains in regard to added vitamins and minerals or other substances, a clear and exhaustive list of ingredients and additives in the product, as well as both the Danish and Latin names for ingredients consisting of plant parts. The products must not contain any illegal doping substances. Sharing the same regulations, our results should apply to all countries in the European Union: that is if regulatory bodies are equally efficient in enforcing these regulations, if manufacturers and distributors in the various countries are equally truthfull in their

TABLE 2

Fetal risk factors for 770 included sons according to use of protein and creatine supplements.

Characteristic	All n = 770	Never users n = 366 (48%)	Current users n = 217 (28%)	Former users n = 187 (24%)
Maternal age at conception (y), mean (SD)	30.4 (4.2)	30.4 (4.2)	30.7 (4.2)	30.2 (4.1)
Paternal age at conception (y), mean (SD)	32.8 (5.7)	32.8 (5.7)	33.1 (5.9)	32.4 (5.3)
Maternal smoking first trimester	180 (23)	73 (20)	49 (23)	58 (31)
Paternal smoking first trimester	220 (29)	103 (29)	56 (27)	61 (33)
Maternal pre-pregnancy body mass index, kg/m^2	22.8 (3.6)	22.8 (3.8)	22.9 (3.5)	22.8 (3.5)
Underweight	45 (6)	21 (6)	12 (6)	12 (7)
Normal weight	549 (73)	268 (75)	149 (71)	132 (73)
Overweight	123 (16)	52 (14)	42 (20)	29 (16)
Obese	31 (4)	18 (5)	6 (3)	7 (4)
Maternal alcohol consumption first trimester				
None	584 (76)	281 (77)	159 (73)	144 (77)
1–2 glasses/wk	150 (19)	67 (18)	46 (21)	37 (20)
>2 glasses/wk	36 (5)	18 (5)	12 (6)	6 (3)
Family occupational status				
High-grade professional	258 (34)	111 (30)	82 (38)	65 (35)
Low-grade professional	267 (35)	130 (36)	75 (35)	62 (33)
Skilled and unskilled workers	212 (28)	103 (28)	53 (24)	56 (30)
Students and economically inactive	33 (4)	22 (6)	7 (3)	4 (2)

Note: Values are presented as *n* (%), unless specified otherwise. SD = standard deviation.

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marketing, and if consumers to the same extent buy protein supplements through alternative unregulated channels (e.g., via the Internet). Our results cannot be extrapolated to populations of countries with more liberal regulations making it more likely for the consumer to acquire adulterated products.

Besides contamination of PS, the phytoestrogenic nature of soy could pose a risk to semen quality. However, studies on soy supplementation have yielded conflicting results. In a study of 10 resistance-trained men assessing the effects of soy and whey protein supplementation on serum concentrations of sex hormones following heavy resistance training, a lower acute testosterone response was observed, when the supplement consisted of soy protein rather than whey and placebo protein (22). Another study including 99 men identified from infertile couples found that men with the highest soy food intake had 41 million sperm cells/mL less than men not consuming soy foods (95% CI −74 to −8) (14). In contrast, a study comparing 10 fertile with 48 infertile men reported favorable effects of isoflavone intake on

TABLE 3

Semen quality characteristics of the study population (N = 770) according to use of protein supplements.

Semen quality characteristics	n	All Median (5th; 95th)	Never users Median (5th; 95th)	Current users Median (5th; 95th)	Former users Median (5th; 95th)
Sexual abstinence, days	768	2 (0.5; 4.5)	2 (0.5; 4.5)	2 (0.5; 5)	2 (0.5; 4)
Semen volume, mL[a]	629	3 (1; 5)	3 (1; 5)	3 (1; 5)	2 (1; 5)
Sperm concentration, million/ml	770	38 (3; 134)	36 (3; 137)	42 (5; 129)	36 (2; 133)
Total sperm count, million[a]	629	95 (7; 400)	90 (9; 318)	108 (10; 404)	93 (5; 409)
Progressive sperm, %	758	65 (34; 84)	65 (30; 84)	65 (36; 85)	65 (38; 84)
Nonprogressive sperm, %	758	6 (1; 17)	6 (1; 19)	5 (1; 17)	6 (1; 16)
Immotile sperm, %	758	28 (13; 55)	28 (13; 58)	28 (13; 54)	27 (12; 50)
Morphologically normal sperm, %[b]	706	6 (0; 15)	6 (0; 15)	6 (1; 15)	6 (0; 15)

[a] Samples collected with spillage excluded.
[b] Analyses are ongoing.

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TABLE 4

Semen quality characteristics according to use of protein supplements.

Semen quality characteristics	Crude % (95% CI)	Overall *P* value	Adjusted[b] % (95% CI)	Overall *P* value
Semen volume, mL[a]				
Never user	0 (ref)		0 (ref)	
Former user	−3 (−14; 9)	0.678	−2 (−14; 12)	0.961
Current user	2 (−8; 14)		−1 (−13; 13)	
Sperm concentration				
Never user	0 (ref)		0 (ref)	
Former user	−2 (−16; 15)	0.940	1 (−15; 19)	0.379
Current user	1 (−13; 17)		−10 (−25; 7)	
Total sperm count[a]				
Never user	0 (ref)		0 (ref)	
Former user	−4 (−20; 17)	0.381	−1 (−18; 20)	0.802
Current user	11 (−7; 32)		6 (−13; 29)	
Progressive sperm				
Never user	0 (ref)		0 (ref)	
Former user	−4 (−11; 3)	0.378	−1 (−8; 8)	0.972
Current user	−4 (−11; 3)		0 (−7; 9)	
Nonprogressive sperm				
Never user	0 (ref)		0 (ref)	
Former user	−8 (−19; 6)	0.378	−5 (−18; 10)	0.547
Current user	−13 (−24; −1)		−8 (−21; 7)	
Immotile sperm				
Never user	0 (ref)		0 (ref)	
Former user	−4 (−11; 4)	0.095	0 (−8; 8)	0.801
Current user	−2 (−9; 5)		2 (−6; 11)	
Morphologically normal sperm				
Never user	0 (ref)		0 (ref)	
Former user	1 (−12; 17)	0.612	4 (−10; 21)	0.845
Current user	2 (−11; 16)		3 (−12; 23)	

Note: CI = confidence interval; ref = reference.
[a] Samples with spillage excluded.
[b] Adjusted for parental smoking, occupational status, and ages at conception, maternal pre-pregnancy body mass index, maternal alcohol consumption, sons' congenital and urogenital malformations, son's tobacco and e-cigarette use, body mass index, fat, bone, and muscle percentages, consumption of alcohol, use of marijuana, ecstasy, and cocaine, exercise, sexual abstinence time, clinic of analysis, place of ejaculation, and season. Analyses of motility further adjusted for time from sample collection to analysis.

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sperm counts and lower levels of sperm DNA damage (12), whereas a trial evaluating the reproductive effects of daily supplementation of 40 mg isoflavone for 2 months found no changes in semen quality or reproductive hormone levels compared with pre-supplementation levels (n = 14) (13). In the present study, the primary source of protein used was whey (63%) and creatine (43%), and only 5% of current and former PS users reported use of soy-based supplements. The study was thus underpowered to examine protein-specific associations of soy.

Our study has several strengths. Most importantly, it was based on a large sample of young healthy men with limited insights into their fertility potential, making self-selection bias due to underlying disease of lesser concern (23). The thorough baseline questionnaire on health behaviors before the clinical examination enabled adjustment for several factors related to both the use of PS and semen quality characteristics such as exercise frequency, smoking habits, and alcohol consumption. This was especially important, because users may exhibit behavior negatively related to reproductive health, such as the use of anabolic steroids or excessive exercise that could lead to an overestimation of an association, while at the same time exhibiting health-promoting behaviors, for example, in regard to smoking and body composition, that could mask a potential negative association between PS and semen quality. However, residual confounding from rather crude assessments (never; ever) of marijuana, ecstasy, and cocaine use cannot be ruled out. Another important strength was our ability to include detailed information on fetal risk factors.

Our study also has limitations. Information on PS use relied on self-report,and we did not specifically ask about use of other sports nutrition supplements such as energy supplements. If such products were widely used among never users of PS and if these products were also subject to contamination, this could lead to an attenuation of results. Furthermore, although we asked about timing of PS use, we did not ask about the amount used, and we can therefore not be sure that the exposure contrast was sufficient. Limitations also include the cross-sectional design and the possibility of selection bias among the sons who chose to participate (response rate 18%). However, the response rate was within the expected range based on previous reports on studies on semen quality (24, 25) including the semen study among young Danish men presenting for the compulsory medical examination upon conscription (26). Another limitation is the temporality between PS assessment and delivery of the semen sample. As the spermatogenic cycle takes 2−3 months from meiosis to differentation, an exposure that affects spermatogenesis would have an estimated onset time of at least 2−3 months, although effects on motility might be short term. The median time between completion of the questionnaire and the clinical examination was 26 days (mean 51 days), and it is therefore uncertain whether the semen sample sufficiently reflected exposure of that exact period. Furthermore, never users starting PS use and current users stopping in the intermediate period between questionnaire answering and sample provision could have caused an attenuation of association.

In conclusion, this study showed no association between the use of PS and semen quality parameters among healthy young men. Although we did not find indications of a harmful effect on semen quality in this study, we encourage others to study this as well, as even a small harmful effect would have a large impact on the population level due to the widespread use of protein supplements in the population.

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La calidad del semen en hombres jóvenes sanos que toman suplementos proteicos

Objetivo: Estudiar la asociación entre el uso de suplementos proteícos (SP) y la calidad del semen entre los hombres jóvenes.

Diseño: estudio transversal.

Ajuste: no aplicable

Paciente (s): Utilizamos datos recogidos de la cohorte Fetal Programming of Semen Quality (FEPOS), que representa una sub-muestra de 778 hombres cuyas madres estaban inscritas en el registro Danish National Birth Cohort entre 1996 y 2002.

Intervención (es): se recogieron muestras de semen desde abril de 2017 a marzo de 2019. Las diferencias relativas en las características del semen según el uso auto informado de SP se estimó con una regresión binomial negativa ajustada por factores de estilo de vida, incluido el ejercicio, el índice de masa corporal, y el uso de esteroides anabólicos, y factores maternos y paternos que potencialmente confunden la asociación entre SP y la calidad del semen.

Principales medidas de resultado: la regresión binomial negativa mostró el mejor ajuste y se utilizó para estimar la diferencia porcentual con el 95% del intervalo de confianza en volumen de semen, concentración de esperma, recuento total de espermatozoides, proporciones de progresivos, no progresivos e inmóviles y porcentaje de espermatozoides morfológicamente normales en los consumidores anteriores y actuales de SP en relación con varones que nunca los utilizaron.

Resultado (s): Los SP fueron utilizados actualmente por el 28% y anteriormente por el 24% de los participantes. El uso de los SP no se asoció con una calidad de semen reducida en términos de volumen de semen, concentración de espermatozoides, recuento total de espermatozoides, morfología o motilidad en análisis brutos o ajustados.

Conclusión: Este estudio no mostró asociación entre el uso de los SP y las características de calidad del semen. Aún así, alentamos a otros grupos a repetir el estudio, ya que incluso un pequeño efecto dañino tendría un gran impacto en el nivel de la población debido al uso generalizado de los SP entre los varones jóvenes.