

Factors affect progressive sperm motility

Factores que afectan la motilidad espermática progresiva

Süleyman Sagır^{1*} and Adem Tunçekin²

¹Department of Urology, Artuklu University Medical School, Mardin; ²Department of Urology, Uşak University Medical School, Uşak, Turkey

Abstract

Objective: In this study, it was aimed to investigate the effects of age, body mass index, and diet factors on sperm parameters and developing a novel index (Artuklu Sperm Quality Index [ASQI]). **Method:** The study incorporated a total of 115 patients who sought medical attention due to infertility and underwent semen analysis (spermiogram). The ASQI score was developed. **Results:** About 73% reported eating three meals daily, while 62% consume fruits a few times a week. When considering grain consumption, 30% rarely do, mirroring the 25% who never do. Carbonated drinks are consumed a few times in 15 days by 39% of respondents. Salt consumption showed 47% taking very little, whereas 42% consume caffeine very minimally. Sausage/salami is minimally consumed by 44%, and 32% of participants reported never being exposed to air pollution. ASQI score ranges from 6 to 61 point. A lower score indicates good nutrition and quality of life, while a higher score suggests deteriorating nutrition and increasing unhealthy habits. Cronbach alfa value was noted as 0.72. A negative correlation was found between ASQI and sperm progressive motility ($p < 0.001$, $r = -0.405$). **Conclusions:** This study revealed a clear negative correlation between the ASQI score, which signifies deteriorating nutrition and escalating unhealthy habits, and sperm progressive motility.

Keywords: Sperm. Urology. Fertility. Sperm quality.

Resumen

Objetivo: Investigar los efectos de la edad, del índice de masa corporal y de los factores dietéticos sobre los parámetros espermáticos, y desarrollar un índice novedoso. **Método:** El estudio incorporó 115 pacientes que buscaron atención médica debido a infertilidad y que se sometieron a análisis de semen. Se desarrolló la puntuación ASQI. **Resultados:** El 73% informaron que comían tres comidas diarias, mientras que el 62% consumían frutas unas pocas veces a semana. En cuanto al consumo de granos, el 30% rara vez lo hace y el 25% nunca. Las bebidas carbonatadas son consumidas unas pocas veces en 15 días por el 39% de los encuestados. El 47% refieren que toman muy poca sal, mientras que el 42% consumen cafeína de manera muy mínima. Embutido/salami es consumido mínimamente por el 44%. El 32% de los participantes informaron que nunca estuvieron expuestos a contaminación del aire. El puntaje ASQI varía de 6 a 61 puntos. Un puntaje más bajo indica buenas nutrición y calidad de vida, mientras que un puntaje más alto sugiere deterioro de la nutrición y aumento de los hábitos no saludables. El valor alfa de Cronbach fue de 0.72. Se encontró una correlación negativa entre el puntaje ASQI y la motilidad progresiva de los espermatozoides ($p < 0.001$; $r = -0.405$). **Conclusiones:** Este estudio revela una clara correlación negativa entre el puntaje ASQI alto, que significa deterioro de la nutrición y escalada de hábitos no saludables, y la motilidad progresiva de los espermatozoides.

Palabras clave: Esperma. Urología. Fertilidad. Calidad del esperma.

*Correspondence:

Süleyman Sagır

E-mail: dr.sagiroglu414@gmail.com

2444-0507/© 2024 Academia Mexicana de Cirugía. Published by Permamyner. This is an open access article under the terms of the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Date of reception: 17-03-2024

Date of acceptance: 03-05-2024

DOI: 10.24875/CIRUE.M24000812

Cir Cir (Eng). 2025;93(1):47-53

Contents available at PubMed

www.cirugiaycirujanos.com

Introduction

Approximately 15% of people globally (equivalent to 60-70 million couples) experience infertility, with male-related issues accounting for 40-50% of these instances^{1,2}. A comprehensive review of 185 studies, which analyzed data from over 42,000 men without identified fertility problems, highlighted a concerning 50-60% decrease in human semen quality, such as sperm concentration and count, over the past four decades³. This decline in sperm quality, a universal issue, is especially pronounced in developed and industrialized regions. This suggests that modifiable lifestyle elements may be significant contributors. Key suspected causes include pollution, stress, smoking, alcohol intake, food pesticides, and poor dietary habits. Both developed and developing nations are witnessing a rise in the consumption of nutrient-poor, calorie-dense foods, often characterized as the Western-style diet. This diet not only impacts fertility but also has been linked to metabolic disorders and conditions like type 2 diabetes, hypertension, and cardiovascular diseases^{4,5}.

Many studies have investigated how various risk factors negatively affect the protein makeup of sperm^{6,7}. Beyond diseases, an increasing number of elements are noted to adversely impact male fertility. Age is a primary factor; while men can reproduce throughout their lives, there is a noticeable decline in sperm quality from age 35 onward. Other elements affecting fertility include diet, caffeine consumption, weight, exercise levels, stress, smoking, drug or alcohol usage, medication intake, diabetes, exposure to artificial chemicals, clothing choices, and sleep patterns^{8,9}.

In this study, it was aimed to investigate the effects of age, body mass index (BMI), and diet factors on sperm parameters and developing a novel index (Artuklu Sperm Quality Index [ASQI]).

Method

The study incorporated a total of 115 patients who sought medical attention due to infertility and underwent semen analysis (spermiogram). For each patient, comprehensive data were recorded, which included: age, weight, height, BMI, dietary habits, nutritional contents of their consumed foods, quantity and frequency of their food consumption, and semen analysis parameters.

Only patients who had normal testicular examination findings were included in the study. In addition, ultrasound examinations were conducted to ensure that the patients had normal testicular size and echogenicity. Patients with a history or clinical evidence of testicular atrophy, testicular torsion, or those who had undergone orchiopexy were excluded from the study.

The ethical approval was obtained from Artuklu University Local Ethical Committee (no: 2023/8-2, date: August 07, 2023). After obtaining Ethics Committee approval, data were collected from the patients through a survey. Informed consent was obtained from all patients.

Definition of the ASQI

In this study, a 15-question questionnaire was developed using the patients' BMI, dietary habits, substance use, and habits of smoking and alcohol consumption. The scoring of this questionnaire is presented in table 1. The ASQI score ranges from 6 to 61 points. A lower score indicates good nutrition and quality of life, while a higher score suggests deteriorating nutrition and increasing unhealthy habits. The Cornchbach alfa value was noted as 0.72 (Table 1).

Statistical analysis

The data analysis was conducted using IBM SPSS 26.0 software (IBM, Armonk, New York, US). We assessed data distribution with the Shapiro-Wilk and Kolmogorov-Smirnov tests. Data following a normal distribution were expressed as mean and standard deviation. We presented categorical variables as count and percentage. The Pearson correlation test was employed to evaluate the correlation of the ASQI. A p value below 0.05 was deemed statistically significant.

Results

The study encompassed a diverse range of 115 patients, capturing varying demographics and lifestyle habits. When broken down by age, the younger participants (18-25 years) accounted for 31%, with 36 individuals in this bracket. However, the most prominent age group was 26-35 years, representing 57% or 65 individuals. Those between 36 and 45 years made up 10% with 12 individuals, and the smallest group, those over 46 years,

Table 1. Artuklu Sperm Quality Index

1	Number of meals eaten per day				
Definition	Once	Twice	3 times	4 times	5 times
Point	1	2	3	4	5
2	Number of water drink per day				
Definition	> 11 glasses	8-10 glasses	5-7 glasses	3-5 glasses	< 3 glasses
Point	1	2	3	4	5
3	Number of fast-food eaten per day?				
Definition	Never	A few in a month	A few in 2 weeks	A few in a weeks	Everyday
Point	0	1	2	3	4
4	How many times do you eat fruit?				
Definition	Every day	A few in a week	A few in a month	Rare	Never
Point	1	2	3	4	5
5	How many times do you consume grains?				
Definition	Every day	A few in a week	A few in a month	Rare	Never
Point	1	2	3	4	5
6	How many times do you consume carbonated drinks?				
Definition	Never	A few in a month	A few times in 15 days	Daily 1-2 times	Daily>3 times
Point	0	1	2	3	4
7	How much salt do you consume?				
Definition	Never	Very little	Little	Moderate	So much
Point	0	1	2	3	4
8	How much do you consume caffeine?				
Definition	Never	Very little	Little	Moderate	So much
Point	0	1	2	3	4
9	How much do you consume sausage/salami?				
Definition	Never	Very little	Little	Moderate	So much
Point	0	1	2	3	4
10	How much are you exposed to air pollution?				
Definition	Never	Little	Moderate	So much	
Point	0	1	2	3	
11	BMI				
Definition	< 20	20, 1-25	25, 1-30	30, 1-25	35
Point	1	2	3	4	5
12	Smoke				
Definition	Never	A few in a month	A few times in 15 days	Daily a few	Min 1 packet a day
Point	0	1	2	3	4

(Continues)

Table 1. Artuklu Sperm Quality Index (*continued*)

13	Alcohol abuse				
Definition	Never	A few in a month	A few times in 15 days	Daily a few	
Point	0	1	2	3	
14	Substance abuse				
Definition	No	Yes			
Point	0	1			
15	Active phone use (daily)				
Definition	< 1 h	2-3 h	3-4 h	4-5 h	5 h
Point	1	2	3	4	5

Total score between 6 and 61.

comprised 2% or 2 individuals. In assessing BMI, a notable 48% ($n = 55$) had a BMI ranging from 20.1-25, suggesting a majority had a healthy weight. Those below 20 constituted 8% ($n = 9$), while 30% ($n=34$) fell within the 25.1-30 range. The overweight bracket (30.1-35) held 11% or 13 patients, and the higher end of the scale, with a BMI over 35, had four patients, making up 3% of the total. Regarding marital status, a significant 75% ($n = 86$) were married, while the unmarried group constituted 25% or 29 patients. As for education, almost half, 47% or 54 patients had completed high school. University graduates followed at 23% ($n = 27$), primary school attendees at 14% ($n = 16$), and those who finished secondary school at 16% ($n = 18$). Lifestyle habits also offered intriguing insights. Almost half of the participants, 49% or 56 patients were smokers. Those who consumed alcohol regularly stood at 10% ($n = 11$), and a minimal 2% or two individuals reported substance abuse (Table 2).

The questions we posed to patients related to their dietary habits are summarized in table 3. In summary, 73% reported eating three meals daily, while 62% consume fruits a few times a week. When considering grain consumption, 30% rarely do, mirroring the 25% who never do. Carbonated drinks are consumed a few times in 15 days by 39% of respondents. Salt consumption showed 47% taking very little, whereas 42% consume caffeine very minimally. Sausage/salami is minimally consumed by 44%, and 32% of participants reported never being exposed to air pollution.

A negative correlation was found between ASQI and sperm progressive motility ($p < 0.001$, $r = -0.405$) (Fig. 1).

Table 2. Demographic data

Parameter	n	%
Age		
18-25	36	31
26-35	65	57
36-45	12	10
> 46	2	2
BMI		
< 20	9	8
20.1-25	55	48
25.1-30	34	30
30.1-35	13	11
> 35	4	3
Marital status		
Married	86	75
Not-married	29	25
Highest level of education		
Primary school	16	14
Secondary school	18	16
High school	54	47
University	27	23
Abuses		
Smoke abuse	56	49
Alcohol abuse	11	10
Substance abuse	2	2
Active phone use (daily)		
< 1 h	16	14
2-3 h	13	11
3-4 h	21	18
4-5 h	24	21
> 5 h	41	36
Comorbidities	7	6

Discussion

The principal intent of this study was to investigate the effects of age, BMI, and diet factors on sperm

Table 3. Dietary habits of the patients

1	Number of meals eaten per day				
	Once	Twice	3 times	4 times	5 times
	2 (2%)	21 (18%)	84 (73%)	6 (5%)	2 (2%)
2	How many times do you eat fruit?				
	Every day	A few in a week	A few in a month	Rare	Never
	27 (24%)	72 (62%)	9 (8%)	6 (5%)	1 (1%)
3	How many times do you consume grains?				
	Every day	A few in a week	A few in a month	Rare	Never
	13 (11%)	29 (25%)	9 (8%)	35 (30%)	29 (25%)
4	How many times do you consume carbonated drinks?				
	Never	A few in a month	A few times in 15 days	Daily 1-2 times	Daily > 3 times
	4 (4%)	42 (37%)	45 (39%)	16 (14%)	8 (7%)
5	How much salt do you consume?				
	Never	Very little	Little	Moderate	So much
	2 (2%)	54 (47%)	16 (14%)	41 (35%)	1 (2%)
6	How much do you consume caffeine?				
	Never	Very little	Little	Moderate	So much
	18 (16%)	48 (42%)	22 (19%)	22 (19%)	5 (4%)
7	How much do you consume sausage/salami?				
	Never	Very little	Little	Moderate	So much
	34 (30%)	51 (44%)	12 (10%)	17 (15%)	1 (1%)
8	How much are you exposed to air pollution?				
	Never	Little	Moderate	So much	
	37 (32%)	33 (29%)	32 (28%)	13 (11%)	
9	Number of water drink per day				
	> 11 glasses	8-10 glasses	5-7 glasses	3-5 glasses	< 3 glasses
	44 (38%)	42 (36%)	17 (15%)	11 (10%)	1 (1%)
10	Number of fast-food eaten per day				
	Never	A few in a month	A few in 2 weeks	A few in a week	Everyday
	18 (16%)	43 (37%)	26 (22%)	19 (17%)	9 (8%)

parameters. Derived from a sample of 115 patients, the results have illuminated several correlations and insights that fortify and expand upon existing literature. One major finding was the negative correlation between ASQI and sperm progressive motility. Simply put, as the ASQI score increases, indicating deteriorating nutrition and a rise in unhealthy habits, sperm

motility progressively diminishes. This dovetails with the broader literature, which has underscored the detrimental influence of lifestyle factors such as diet, smoking, and substance use on sperm quality.

A recent meta-analysis of six studies, which included over 8,200 participants, found that those with the lowest adherence to healthy dietary patterns had notably lower

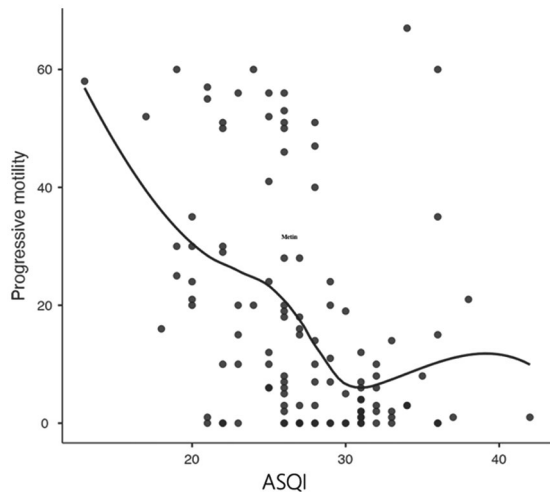


Figure 1. Corellation graph between Artuklu Sperm Quality Index and sperm progressive motility.

sperm concentrations compared to those with the highest adherence⁹. However, this meta-analysis did not identify significant relationships with other sperm quality metrics. Most of the information on how food affects sperm quality is derived from observational studies. A systematic review done¹⁰, which encompassed 35 studies with 12,672 participants, revealed that eating vegetables, fruits, nuts (high in antioxidants), fiber-abundant grains and cereals, fish, other seafood, poultry, and low-fat dairy might bolster sperm quality. On the other hand, diets heavy in processed meats, soy products, potatoes, full-fat dairy, coffee, alcohol, and sugary drinks and treats seem to negatively impact sperm quality. Fruits and vegetables are abundant in antioxidants. These antioxidants may regulate sperm reactive oxygen species (ROS), subsequently lessening sperm DNA damage and enhancing their motility and vitality. Consuming a lot of fruits and vegetables also means a higher intake of folate, which can be beneficial for sperm health. Specifically, Young and his team found that men who consumed more folate were less likely to have sperm aneuploidy¹¹, hinting at folate's critical role in sperm development. Research on animals has shown that a lack of folate in the diet can modify sperm DNA methylation in genes crucial for development and some metabolic functions. Furthermore, male mice on a folate-deficient diet were linked to unfavorable pregnancy results compared to those with adequate folate¹².

A diet focused on fruits, vegetables, fish, legumes, and whole grains characterizes a health-conscious eating pattern. Vujkovic et al.¹³ is the only study that examined this dietary trend. Their findings indicated that men who

followed this health-conscious diet exhibited reduced sperm DNA damage compared to those on a 'traditional Dutch' diet, which is heavy on meat, potatoes, and whole grains but low in sugary drinks and sweets. Interestingly, men who closely followed the 'traditional Dutch' diet had higher sperm concentrations, presenting some contradictory results that require further exploration. Considering nutrition and diet, it seems to affect sperm parameters seriously. Therefore, in our study, we separated nutrition, healthy nutrition, and unhealthy nutrition and included them in the score system. We rated malnourished people high and well-fed low scores.

Although alcohol is widely accepted socially, its negative impact on male reproductive health is well-established. Many studies conducted over the years have highlighted the adverse effects of alcohol intake on male fertility¹¹. Sperm cells, like all living cells, exist in conditions that need oxygen. The metabolism of oxygen produces ROS. Elevated levels of ROS can damage cell membranes and lead to increased DNA fragmentation, as highlighted in studies by Abdel-Zaher et al., and Bakar et al.^{14,15}. This damaging effect is amplified by cigarette and morphine use, which promotes lipid peroxidation. Beyond the overproduction of ROS due to prolonged morphine consumption, opioids can directly reduce testosterone levels, diminish semen quality, lower sperm count, alter sperm morphology, and promote the release of prolactin, as noted by Bolelli et al.¹⁶. However, in our study, almost half of the participants, 49% were smokers. Those who consumed alcohol regularly stood at 10% (n = 11), and a minimal 2% or 2 individuals reported substance abuse. Therefore, thought to include this abuse to the ASQI. However there was a negative correlation between ASQI score and sperm progressive motility.

Our study is the first study in terms of making such a combination and developing a scoring system, but of course, our study also has limitations. While categorizing nutrition into healthy and unhealthy, we may have oversimplified complex dietary patterns. Relying solely on a scoring system may not capture the full nuances of individual diets. In addition, the criteria for "malnourished" versus "well-fed" might not represent the entire spectrum of dietary health, potentially leading to skewed results.

Conclusions

This study revealed a clear negative correlation between the ASQI score, which signifies deteriorating nutrition and escalating unhealthy habits, and sperm progressive motility. Such findings emphasize the

significance of a healthy lifestyle, particularly regarding diet, in maintaining and potentially enhancing sperm quality. This knowledge underscores the crucial need for educational campaigns and proactive interventions targeting lifestyle modifications to combat the observed decline in male fertility, especially in developed regions.

Funding

The authors declare that they have not received funding.

Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Romo-Yáñez J, Sevilla-Montoya R, Pérez-González E, Flores-Reyes J., Laregoiti-Servitje E., Espino.Sosa S. et al. AZFa, AZFb, AZFc and gr/gr Y-chromosome microdeletions in azoospermic and severe oligozoospermic patients, analyzed from a neural network perspective. *Cir Cir*. 2022;90:202-9.
2. Zambrano Serrano CA, Carvajal Obando A. Diagnosis and hormonal treatment of male infertility. *Actas Urol Esp (Engl Ed)*. 2020;44:321-7.
3. La Vignera S, Calogero AE, Condorelli R, Garrone F, Vicari E. Spermogram: techniques, interpretation, and prognostic value of results. *Minerva Endocrinol*. 2007;32:115-26.
4. Ibitoye BO, Fasasi AO, Imosemi IO. The spermogram and correlation of seminal fluid parameters in patient attending fertility centre in Lagos, South West Nigeria. *Morphologie*. 2023;107:100606.
5. Gazibera B, Gojak R, Drnda A, Osmic A, Mostarac N, Jusufi-Huric I, et al. Spermogram part of population with the manifest orchitis during an ongoing epidemic of mumps. *Med Arch*. 2012;66:27-9.
6. Garrido N, Hervás I. Personalized medicine in infertile men. *Urol Clin North Am*. 2020;47:245-55.
7. Gottardo F, Kliesch S, World Health Organization. Ejakulatdiagnostik: spermogramm nach WHO-Kriterien 2010 [Semen analysis: spermogram according to WHO 2010 criteria]. *Urologe A*. 2011;50:101-8.
8. Rezayat AA, Asadpour AA, Yarahmadi A, Ahmadian H, Hakkak AM, Soltani S. Association between serum vitamin D concentration with spermogram parameters and reproductive hormones among infertile Iranian males: a cross-sectional study. *Reprod Sci*. 2022;29:270-6.
9. Arab A, Rafie N, Mansourian M. Dietary patterns and semen quality: a systematic review and meta-analysis of observational studies. *Andrology*. 2017;10:1-9.
10. Salas-Huetos A, Bulló M, Salas-Salvadó J. Dietary patterns, foods and nutrients in male fertility parameters and fecundability: a systematic review of observational studies. *Hum Reprod Update*. 2017;23:371-89.
11. Young SS, Eskenazi B, Marchetti FM, Block G, Wyrobek AJ. The association of folate, zinc and antioxidant intake with sperm aneuploidy in healthy non-smoking men. *Hum Reprod*. 2008;23:1014-22.
12. Lambrot R, Xu C, Saint-Phar S, Chountalos G, Cohen T, Paquet M, et al. Low paternal dietary folate alters the mouse sperm epigenome and is associated with negative pregnancy outcomes. *Nat Commun*. 2013;4:2889.
13. Vujkovic M, De Vries JH, Dohle GR, Bonsel GJ, Lindemans J, Macklon NS, et al. Associations between dietary patterns and semen quality in men undergoing IVF/ICSI treatment. *Hum Reprod*. 2009;24:1304-12.
14. Abdel-Zaher AO, Mostafa MG, Farghaly HS, Hamdy MM, Abdel-Hady RH. Role of oxidative stress and inducible nitric oxide synthase in morphine-induced tolerance and dependence in mice. Effect of alpha-lipoic acid. *Behav Brain Res*. 2013;247:17-26.
15. Bakar NH, Hashim SN, Mohamad N, Husain R, Adnan LH, Shariff H, et al. Role of oxidative stress in opiate withdrawal and dependence: exploring the potential use of honey. *J Appl Pharm Sci*. 2015;5:159-61.
16. Bolelli G, Lafisca S, Flaminio C, Lodi S, Franceschetti F, Filicori M, et al. Heroin addiction: relationship between the plasma levels of testosterone, dihydrotestosterone, androstenedione, LH, FSH, and the plasma concentration of heroin. *Toxicology*. 1979;15:19-29.