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Research Article

Male lifestyle habits and in vitro fertilization outcomes: The effects of alcohol and smoking on sperm characteristics and pregnancy rates

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ABSTRACT

A study of the effects of male smoking and alcohol consumption on the outcomes of the In Vitro Fertilization treatments involving young, fertile oocyte donors in Northern Cyprus. Data from 124 consecutive IVF cycles were analyzed retrospectively. Patient files and clinical records were used to collect information on male smoking and alcohol habits, semen analysis parameters, and IVF outcomes. SPSS software was one of the statistical techniques used to compare the results of several groups according to their alcohol and smoking habits. Statistical significance was set at a p-value of less than 0.05. The normal concentration of sperms, the morphology and motility rate were considerably less in the smokers and drinkers group than in the nonsmokers and non-drinkers group, by 14%, 8.1% and 15.2%, correspondingly. Furthermore, for males over 40, the drinking and smoking group has a considerably reduced proportion of normal sperm volume by 7% compared to the equivalent group for males under 40. This research shows that the act of smoking and the consumption of alcohol by males lessen the quality of sperm and have a negative influence on the outcomes of in vitro fertilization. The percentage of positive beta-human chorionic gonadotropin was about 21% lower in males who smoke and drink than those who abstain. These findings highlight the significance of providing counseling to males undergoing IVF regarding the potential adverse effects of these lifestyle habits on their fertility potential.

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INTRODUCTION

Infertility affects millions of couples worldwide. The inability to become pregnant after a year of sexual activity without the use of contraception is known as infertility. Numerous causes can lead to infertility, including aging in women, hormone imbalances, abnormalities in the uterus, and male issues such as low motility or sperm count [1]. A variety of medical procedures known as assisted reproductive technologies, or ART, are intended to help couples who fail to achieve pregnancy. The process of retrieving eggs from a woman's ovaries, fertilizing them with sperm in a controlled laboratory setting, and then transferring the resultant embryos to the woman's uterus is known as in vitro fertilization, or IVF. Intracytoplasmic sperm injection (ICSI) is a process that involves carefully inserting a single sperm into an egg which is frequently used when the male partner is infertile [2]. The complex process of sperm creation that takes place in the testes' seminiferous tubules is known as spermatogenesis. During childhood into the future, this amazing biological event continues unabated, guaranteeing a consistent supply of male gametes for possible fertilization. The process of spermatogenesis consists of several well phases that work together to produce good quality sperm cells. [3]. Egg development, or oogenesis, is an exceptional example of cellular biology that is carefully regulated inside the ovaries. Oogenesis starts during fetal development and progresses through a number of discrete phases, in contrast to spermatogenesis, which happens constantly all while a male's period of reproduction [4].

Even though assisted reproductive technologies have advanced significantly over the past 25 years, researchers are still attempting to identify additional variables that influence the outcome of IVF. This paper will show the effect of male smoking and drinking alcohol on the endpoints of IVF [5]. According to [6] smoking affects sperm negatively, in [7] found that smoking and alcohol impact the DNA of the sperm. Research has demonstrated the effects of smoking on a variety of biological levels such as sperm production [8], and analysis of the epidemiological literature, smoking cigarettes is linked to slight declines in motility [9]. Additionally, smoking is a major worldwide health threat that leads to a number of fatal diseases [10]. There is strong evidence that couples should be informed about the potential effects of smoking on the results of IVF treatments years in advance [11]. Few researches have examined how drinking alcohol affects a man's ability to conceive. Testicular shrinkage in men is linked to heavy alcohol consumption [12]. Male factors are considered to be responsible for thirty to fifty percent of cases of infertility. A few reasons for infertility or decreased fertility include endocrinopathies, age, congenital anatomical characteristics, gonadotoxic exposures, lifestyle choices, and dysfunctional testicles. A comprehensive medical history, a focused physical examination, and particular laboratory tests, including semen analysis, are all components of the male infertility screening procedure [13]. Ovarian insufficiency, diminished ovarian reserve, and male factor are the most frequent causes of infertility among the patients in this study.

All in vitro fertilization patients are ready to change their lifestyle. Therefore, it is important to ensure that people understand the healthy habits that can improve the chances of having an effective IVF cycle [14]. Therefore, the purpose of this research was to examine the effect of smoking and alcohol consumption for male on the outcomes of in vitro fertilization process using young, fertile oocyte donors in Northern Cyprus. The findings of this research should prove that lifestyle choices have an impact on the results of IVF. Figure 1 below illustrates our study's methodology and driving forces.

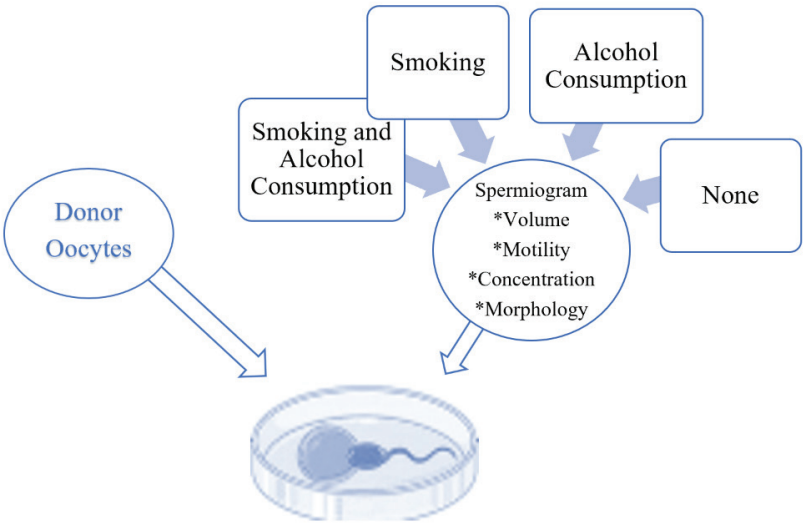

Figure 1. Alcohol and cigarette consumption by males versus the IVF results.

MATERIALS AND METHODS

Almost 124 consecutive IVF treatment cycles for young fertile oocyte donors between 2015 and 2023 at Near East University Hospital are included in this clinical data analysis. Patient files and clinical outcome records were the sources of the data. One type of embryo transfer cycle was examined in this study, which is IVF (in vitro fertilization–embryo transfer). Methods of treatment utilizing regular IVF, donor embryos, or donor sperm were excluded. Three classifications were used and tested to examine the effects of Alcohol and cigarette consumption, on the characteristics of human sperm and the outcomes of IVF.

To test the hypothesis When the standard deviation (σ) is unknown and n is less than 30, regarding the mean of the normal population, first, a small sample size n was assumed, where n represents the observations within the normally distributed population. Given that (r) is an unbiased estimate of σ and x is the sample mean [15].

$$H_0 : \mu = \mu_0 \; and \; H_1 : \mu \neq \mu_0 \; (two \; tailed)$$

After deciding the hypothesis and the Null hypothesis, a significance level (α) for the degree of freedom (D), should be determined by:

$$p\left(\underline{x} - t_{\frac{\alpha}{2}(D)} \frac{r}{\sqrt{n}}\right) = 1 - \alpha$$

Then the t-value can be calculated by using $t = \frac{\underline{x} - \mu_0}{\frac{r}{\sqrt{n}}}$

And the critical region was $|t| \geq t_{\frac{\alpha}{2}(D)}$

While, for two small samples taken from a normally distributed population, that have μ_1 and μ_2 as the mean of each sample and σ_1, σ_2 as the standard deviation for each, then, to calculate the standard error of the mean difference, let $\sigma_1 \neq \sigma_2$ and r_1 *and* r_2 be the sample estimations, then

$$r_{\underline{x}_1 - \underline{x}_2} = \sqrt{\frac{r_1^2}{n_1} + \frac{r_2^2}{n_2}}$$

The difference of the mean should have a certain value, so the hypothesis and null can be written as:

$$H_0: \mu_1 - \mu_2 = \Delta \; and \; H_1: \mu_1 - \mu_2 \neq \Delta \; (two \; tailed)$$

The significance level (α) for the degree of freedom (D), should be determined by:

$$p(\underline{x}_1 - \underline{x}_2 - t_{\frac{\alpha}{2}(D)} \sqrt{\frac{r_1^2}{n_1} + \frac{r_2^2}{n_2}} < \mu_1 - \mu_2 < \underline{x}_1 - \underline{x}_2 + t_{\frac{\alpha}{2}(D)} \sqrt{\frac{r_1^2}{n_1} + \frac{r_2^2}{n_2}}).$$

Then, the t-value can be calculated by:

$$t = \frac{\underline{x}_1 - \underline{x}_2 - \Delta}{\sqrt{\frac{r_1^2}{n_1} + \frac{r_2^2}{n_2}}}$$

And the critical region was $|t| \geq t_{\frac{\alpha}{2}(D)}$

A researcher's goal is frequently to determine whether the frequency of examples with a particular characteristic varies across levels of a factor or across combinations of levels of two or more factors. The chi-square test of goodness of fit is the proper test to use in these circumstances [16], given by:

$$x^2 = \sum \frac{(Observed \; value - Expected \; value)^2}{Expected \; value}, \text{ using } \alpha = 0.05$$

Drinking alcohol and smoking information for each male patient was checked from his medical records, which were normally created during the patient's initial visit to the clinic.

Table 1 displays the analysis of semen. designed by WHO according to [17], and table 2 represents the whole sample's clinical statistics taken from the IVF clinic in the Near East Hospital in Northern Cyprus.

Table 1. Normal limits of reference for semen analysis

Volume (*ml*)	>1.5
Concentration (× 10^6.ml^{-1})	> 39
pH	> 7.2
Motility (%)	> 32
Morphology (*Krufer*)	=> 4
Viscosity following liquefaction (*cm*)	< 2

Table 2. Clinical data gathered from Near East Hospital's IVF facility

Clinical Features	***The entire sample size (n = 124)***
BMI (Kg.s^{-2}), mean ±s.d. (*range*)	25.27 ± 4.01 (18.34-39.06)
Concentration of sperm (× 10^6.ml^{-1})	63.83 ± 52.21 (3-270)
Morphology of sperm (*Kruger*)	3.79 ± 3.27 (1-14)
Volume of sperm (*ml*)	3.09 ± 1.70 (0.30-10.60)
Motility of sperm %	42.87 ± 20.76 (0-90)
Age (*year*), mean ± s.d. (*range*)	42.2 ± 8.8 (22-67)

Table 3. Males' Drinking and smoking behaviors percentage in the sample

Lifestyle choices of men based on drinking and smoking	**The sample's Rate**
Alcohol status (%)	
abstainers	64.5%
Social Alcoholic	26.5%
Heavy drinkers	9%
Smoking and Alcohol status (%)	
Nonsmokers and abstainers	39.5%
At least one of the two habits	39.5%
Smokers and drinkers	21%
Smoking status (%)	
Nonsmokers	53.2%
Moderate smokers	15.3%
Heavy smokers	31.5%

BMI: body mass index; s.d.: standard deviation;

Data Analysis and Formulations

Almost 124 consecutive IVF treatment cycles for young fertile oocyte donors between 2015 and 2023 at Near East University Hospital are included in this clinical data analysis.

Table 3, displays the status of the research sample according to their life-style in drinking and smoking. Of the patients, 53.2%, 15.3%, and 31.5% were nonsmokers, moderate smokers, and heavy smokers. On the other hand, of the male population, 9%, 26.5%, and 64.5% were abstainers, social drinkers, and heavy drinkers, respectively. When it came to social behavior activities, the sample was divided into three groups, the first one consisted of 21% of the patients who were drinkers and smokers (+S/+D; group); the second group consisted of 39.5% were abstainers and nonsmokers (−S/−D; group); and the third one consisted from 39.5% of the patients that had at least one recreational behavior (−S/+D or +S/−D; group). As represented below in figure 2.

Patient files and clinical outcome records were the sources of the data considered in figures 3- 7 that designed data for the study. These are some selected variables and

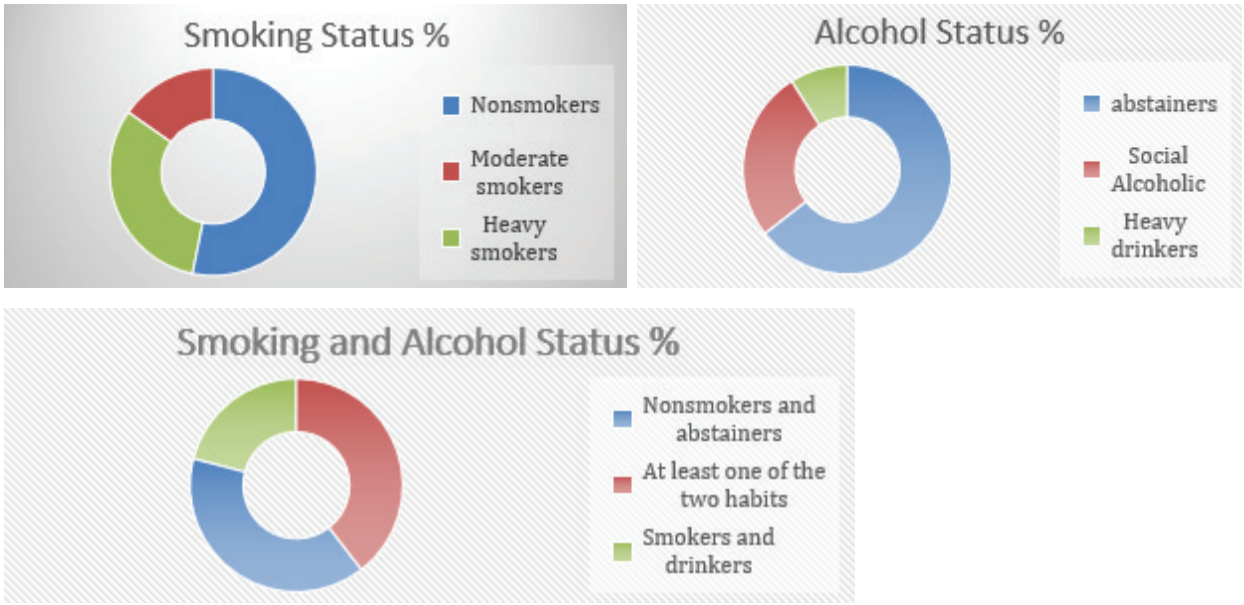

Figure 2. Males' drinking and smoking habits are the basis for the study's behavior patterns

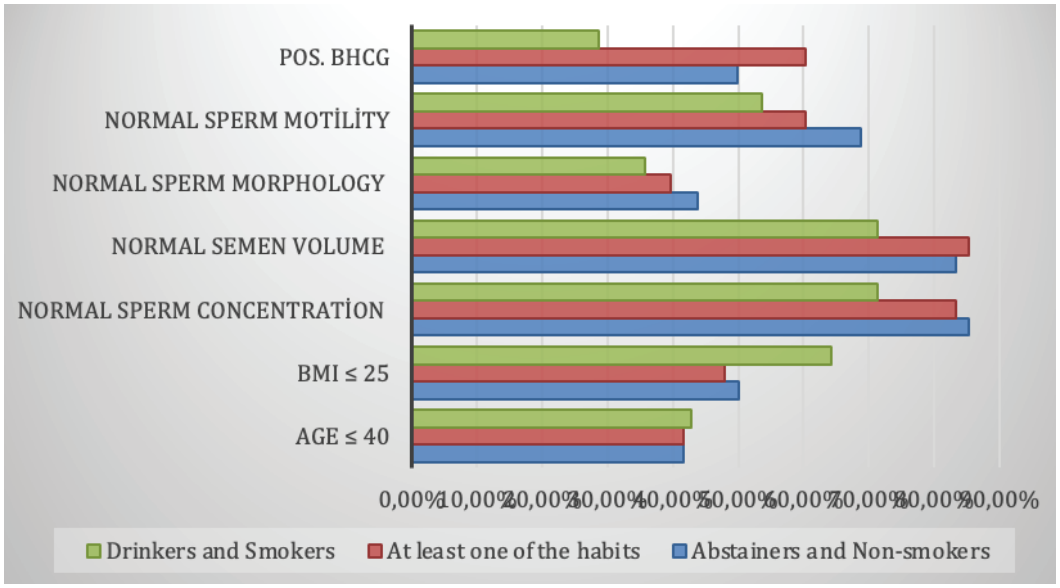

Figure 3. Characteristics of the sample based on male alcohol consumption and smoking.

permeates that are helpful in the analysis of the proposed problems with effective and novel techniques.

Figure 3 describes the male characteristics based on alcohol and cigarette consumption, the comparison was made after finding the percentage of the normal range of the males' age, BMI and each of the four Spermiogram values; the concentration, motility, volume, and morphology.

Figure 4, and Figure 5 describe the male characteristics for negative and positive bHCG respectively, versus the three groups, (+S/+D); (−S/−D); and (−S/+D or +S/−D).

Figure 6 and figure 7 show the effect of age associated with drinking and smoking, the only significant effect was in the volume of the sperm, which was lower for males older than 40 and had the two habits of drinking and smoking.

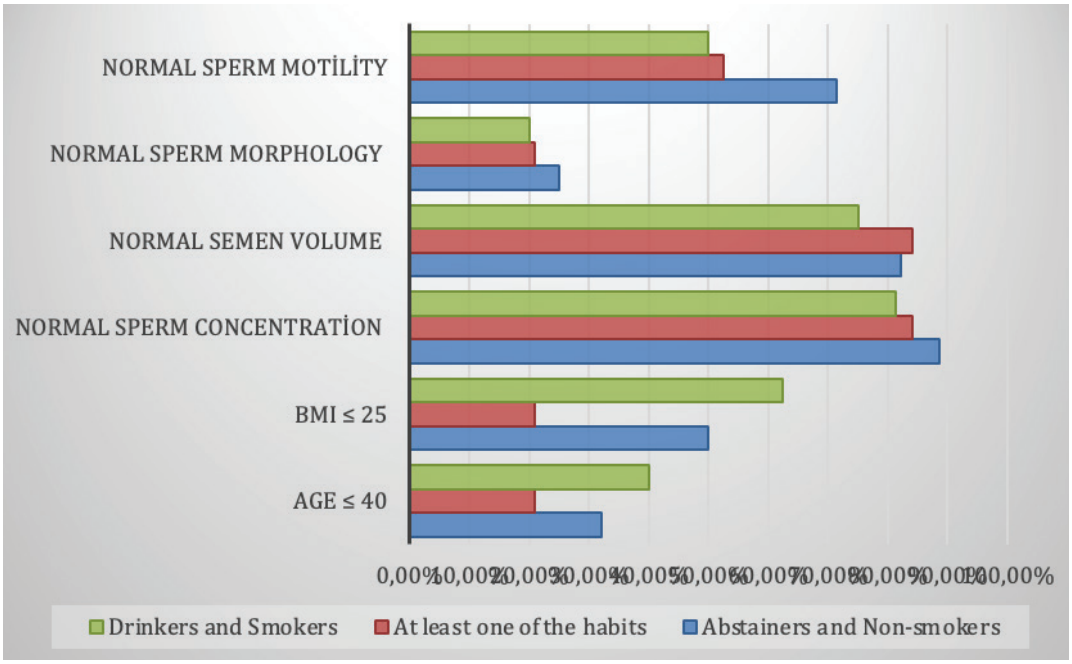

Figure 4. Characteristics of the sample based on the negative results of bHCG.

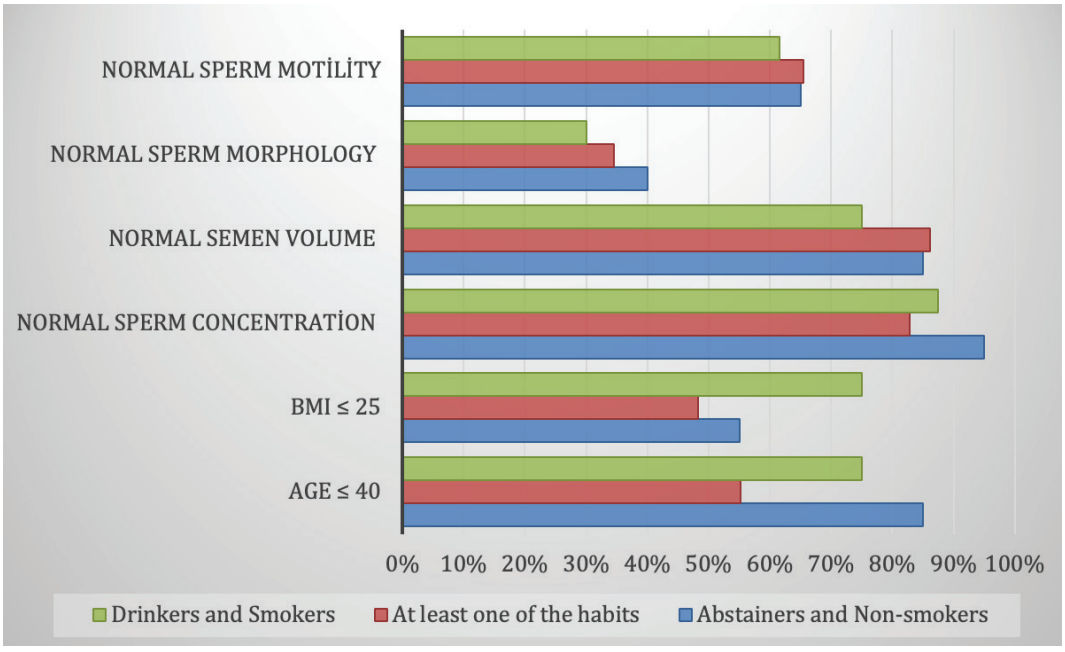

Figure 5. Characteristics of the sample based on positive results of bHCG.

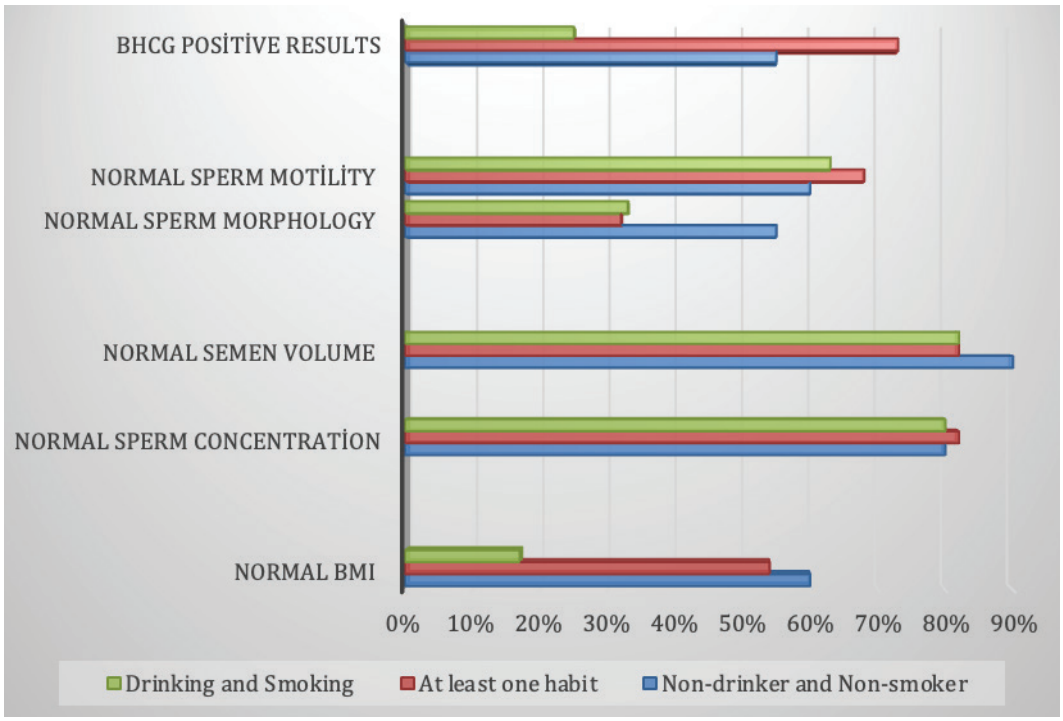

Figure 6. Characteristics of the sample based on the male age (≤40).

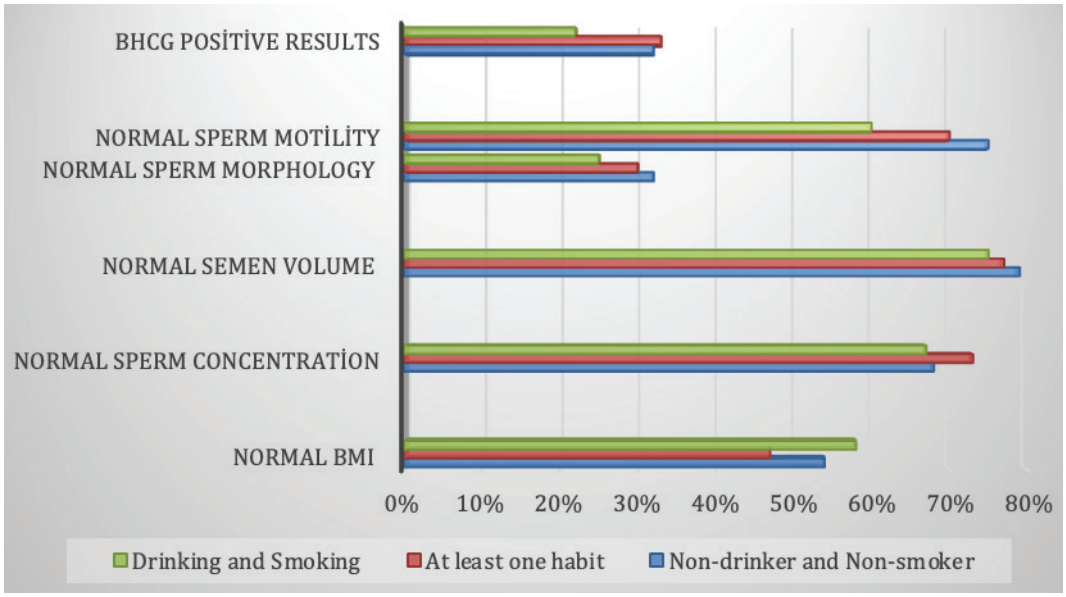

Figure 7. Characteristics of the sample based on the male age (> 40).

RESULTS AND DISCUSSION

The first classification of the data listed in table 4, demonstrates that, in comparison to the non-drinkers and non-smokers group (-D/-S) , the drinkers and smokers group (+D/+S) exhibited substantially decreased morphology , motility, and normal sperm concentration rates by 8.1%, 15.2%, and 14%, correspondingly. Table 4, also shows that there is a significant relation between alcohol and cigarette consumption, and the IVF bHCG positive results, it was 49.9% in non-drinkers and nonsmokers versus 28.6% for drinkers and smokers' group. However, the rates for age groups under 40 were not shown to have significantly correlated with drinking and smoking.

Table 5, describes the second classification of the data, which shows the effect of smoking and alcohol consumption

by males based on the IVF results in the sample. Comparing the percentages of the normal range, the table shows that the percentages of normal sperm concentration, motility, and morphology were significantly lower in the drinking and smoking group than in the nonsmokers and abstainers' group.

The third classification in Table 6, is based on dividing the sample into two groups according to age, less than 40 and more than 40, each group has three categories, (-D/-S; group), (-D/+S OR +D/-S;group), and the third one is (+D/+S;group). After testing each category in both groups, in this situation the percentage of normal sperm volume is significantly lower in the smoking and drinking group for males above 40 years old.

From the three classifications, it was found that cigarettes and alcohol consumption lower sperm concentration, motility, and morphology, while the sperm volume is affected for males above the age of 40, and if the sperm quality is affected that will reduce the possibility for a successful IVF result.

Numerous studies conducted in the last few years have shown the impact of alcohol use on reproductive outcomes like [18-20] and [21], while other research indicates a negative correlation between alcohol use and reproductive outcomes like [22,23] and [24]. Depending on the sample of the population used in this article, table 4 describes the male characteristics based on alcohol and cigarette consumption, the percentage of the normal range is the lowest in the situation of (+D/+S; group), but the results is significant for concentration, motility and morphology, while age and BMI did not show a significant difference. In table 5 , the sample was described by the male characteristics for negative and positive in comparison to the three groups, (+S/+D; group); (−S/−D, group); and (−S/+D or +S/−D; group), respectively, using bHCG. By contrasting the male spermiogram in the positive bHCG (-D/-S; group) with the negative bHCG (+D/+S; group), it was found that the normal percentage of the sperm concentration, motility and morphology, were significantly lower in (+D/+S; group).

According to [25], aging has a cumulatively detrimental effect on semen quality, while, Pasqualotto, et al., 2006 found that the only semen characteristic that seemed to decrease with cigarette consumption was semen volume, and in [26] found that semen volume and sperm motility in a convenience sample of healthy males from a non-clinical context dropped steadily between the ages of 22 and 80. For the

Table 4. Characteristics of the sample based on male Alcohol and cigarette consumption (n=124)

Clinical and Statistical Characteristics	*-D, -S*	*-D, +S or +D,-S*	p_1 *- value*	*+D, +S*	p_2 *- value*
Age ≤ 40	41.7%	41.7%	0.269	42.9%	0.709
Normal BMI	50%	47.9%	0.733	64.3%	0.857
Normal Sperm Concentration	85.4%	83.3%	0.500	71.4%	0.03
Normal Semen Volume	83.3%	85.4%	0.705	71.4%	0.414
Normal Sperm Morphology	43.8%	39.6%	0.850	35.7%	0.03
Normal Sperm Motility	68.8%	60.4%	0.096	53.6%	0.05
bHCG Positive Results	49.9%	60.4%	0.377	28.6%	0.047

BMI: body mass index, -D: abstainer, +D: Drinker, -S: Non-Smoker, +S: Smoker, -D, +S or +D,-S: at least one habit, If p<0.05 then, the data is assumed to be significant, p-values were calculated according to Chi-squared test or T-test, p_1 *- value*: testing -D,-S versus *-D, + S U +D, -S*, p_2 *- value*: testing *-D, -S* versus *+D, +S*.

Table 5. Characteristics of the sample based on the result of bHCG (n=124)

Classifications	Negative bHCG (n=64)			Positive bHCG (n=60)		
	-D, -S	*-D, +S or +D,-S*	*+D, +S*	*-D, -S*	*-D, +S or +D,-S*	*+D, +S*
Age ≤ 40	32.1%	21%	40%	85%	55.2%	75%
Normal BMI	50%	21%	62.5%	55%	48.3%	75%
Normal Sperm Concentration	88.6%*	84.2%	81.3%	95%*	82.8%	87.5%*
Normal Semen Volume	82.1%	84.2%	75%	85%	86.2%	75%
Normal Sperm Morphology	25%*	21%	20%	40%*	34.5%	30%*
Normal Sperm Motility	71.4%*	52.6%	50%	65%*	65.5%	61.5%*

BMI: Body mass index; -D: Abstainer; +D: Drinker; -S: Non-smoker; +S: Smoker; -D,+S or +D,-S: At least one habit; *p-value is statistically significant at the 0.05 level.

Table 6. Characteristics of the sample based on the male age

Attributes	Age ≤ 40 54			Age >40 70		
	-D, -S 37%	*-D, +S or +D,-S* 41%	*+D, +S* 22%	*-D, -S* 40%	*-D, +S or +D,-S* 43%	*+D, +S* 17%
Normal BMI	60%	54%	17%	54%	47%	58%
Normal Sperm Concentration	80%	82%	80%	68%	73%	67%
Normal Semen Volume	90%	82%	82%*	79%	77%	75%*
Normal Sperm Morphology	55%	32%	33%	32%	30%	25%
Normal Sperm Motility	60%	68%	63%	75%	70%	60%
bHCG Positive Results	55%	73%	25%	32%	33%	22%

BMI: Body mass index; -D: abstainer; +D: Drinker; -S: Non-Smoker; +S: Smoker; -D,+S or +D,-S; At least one habit; *p-value is statistically significant at the 0.05 level.

sample classification according to age in table 6, this study shows that the only significant effect of age associated with drinking and smoking was in the normal range of the sperm volume, which was lower for males older than 40 and had the two habits of drinking and smoking. In IVF research, mathematical modeling has emerged as a powerful tool that provides a framework for analyzing and understanding the complex interplay of factors that affect IVF outcomes. When clinical studies and laboratory tests' data are combined with mathematical models, the dynamics of in vitro fertilization (IVF) operations can be replicated [27] and modeling data relted to smoking effects also discussed in [28]. In vitro fertilization mathematical models frequently include statistics, differential equations, and optimization techniques as their basic building blocks. As scientific knowledge advances and new data is incorporated, these models are continuously updated and modified. They help researchers and practitioners make evidence-based decisions, which improves the effectiveness and success rates of IVF treatments while lowering risks and expenses. Several studies measuring the likelihood of follicle fertilization were conducted utilizing fuzzy matrix theory [29].

CONCLUSION

The aim of this study was to evaluate the influence of male smoking and alcohol consumption on the results of In Vitro Fertilization procedures that included young, fertile oocyte donors in Northern Cyprus, this contributes to the work's distinctiveness by illustrating how the daily routine of the male may impact the region's fertility results. The results of our research offer strong evidence that the lifestyle choices of men have a substantial impact on the quality of their sperm and the success rates of In Vitro Fertilization. The impact of a single drinking or smoking behavior on the outcomes of in vitro fertilization was not well supported by the data in this investigation. The analysis revealed that men who smoked and consumed alcohol had significantly lower percentages of normal sperm concentration, motility, and morphology compared to their non-smoking and non-drinking counterparts, while the normal sperm volume percentage was significantly lower when the age is greater than 40 in drinking and smoking group. A strong association was observed between these negative sperm parameters and reduced IVF success rates, as indicated by lower beta-human chorionic gonadotropin -positive results in the smoking and alcohol consumption group. These findings confirm the previous research results highlighting the detrimental effects of smoking and alcohol on male fertility. They emphasize the crucial role of counseling for male partners undergoing of In Vitro Fertilization treatments. If they were more educated about the potential negative consequences of these habits on their sperm health, they could possibly make more conscious decisions about this. In addition to that, our study adds valuable input to the evolving library of information on male lifestyle factors and their impact on of In Vitro Fertilization outcomes in specific populations. That would help healthcare professionals to provide tailored counseling and interventions to optimize fertility potential while improving the chances of successful of In Vitro Fertilization pregnancy.

Recommendation

In addition to considering other factors that may influence the outcome of fertilization, it is crucial to keep in mind that individuals respond differently to aging, drinking, and smoking. To gain a deeper understanding, more meticulously organized research is needed, ideally on a wider range of populations. Using a greater number of participants and ongoing evaluations by gathering information from several IVF clinics in Northern Cyprus will be the following stage in this paper's development. Furthermore, this research will be enhanced and demonstrate the substantial impact on clinical practices and public health by taking into account the differences in lifestyle, cultural customs, and healthcare-related behaviors.

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AUTHORSHIP CONTRIBUTIONS

T,B.: Conceptualization, Methodology, Formal analysis, Writing-original draft, Writing review editing.

M.G.: Conceptualization, Methodology, Formal analysis, Software, Visualization, Writing an original draft,

B.K.: Formal analysis, Software, Visualization, Writing-review editing.

E.H.: Methodology, Formal analysis, Visualization, Methodology,

M.F: Methodology, Formal analysis, Software, Formatting, Writing review, editing.

Ethics approval and consent to participate

DATA AVAILABILITY STATEMENT

The authors confirm that the data that supports the findings of this study are available within the article. Raw

data that support the finding of this study are available from the corresponding author, upon reasonable request.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICS

The study was approved by the members of the Faculty of Medicine, Department of Medical Genetics, Near East University, Center of Excellent and Mathematics research center. All methods were carried out according to relevant guidelines and regulations.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence was not used in the preparation of the article.

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