

THE EFFECTS OF CIGARETTE SMOKING ON SEMEN QUALITY OF INFERTILE AND FERTILE MEN WITH REGARD TO THEIR BODY MASS

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Abstract— In this study the effect of cigarette smoking on semen quality of fertile and infertile men with or without obesity was investigated.

The number of fertile and infertile participants was as following: 203 fertile smokers, 78 fertile non-smokers, 147 infertile smokers and 68 infertile non-smokers. The body mass index (BMI) was measured in all fertile and infertile men. All semen parameters were assessed in both fertile and infertile men with or without obesity to identify the values that would distinguish fertile from infertile men.

The results of this study showed that cigarette smoking has a significant influence only on sperm count, percentage of active sperm and sperm morphology. The semen parameters in infertile men were significantly different from that of fertile men. The influence of body mass index on semen parameters was obvious except in percentage of immotile sperms. This results suggest that the chemical agents or mutagens may affect male reproductive via direct effect on the spermatogenesis.

Key words— Fertile, infertile, obesity, body mass index.

I. INTRODUCTION

Infertility is a condition that affects both men and women of the reproductive age. Infertility is the diminished ability or the inability to conceive and have offspring after one year of unprotected coitus or sex relation. Infertility may be designed as either primary or secondary. Primary infertility is the term used to describe a couple a couple that has never been able to conceive a pregnancy after at least one year of attempting to do so through unprotected intercourse. Secondary infertility is the term used when a couple has conceived previously, but is unable to conceive again (Check, 1995)

Infertility can be due to many causes, as many studies have shown that more than half of causes of infertility are a result of female conditions; the remainders are caused by sperm disorders and by unexplained factors. Male infertility could be caused by many factors such as hormone disorders, illness, reproductive anatomy trauma and obstruction, and/or sexual dysfunction. These factors can temporarily or permanently affect sperm and prevent conception (Harvey, 2008).

Infertility nowadays is on the rise between obese couples in many countries. Obesity immediately brings to mind association with hypertension, diabetes and heart diseases (Manson et al., 1990). Yet most people are surprised to learn that there is an association between obesity and infertility. Epidemiological data confirm that obesity accounts for 6% of primary infertility. Thus 12% of primary infertility result from

deviations in body weight from established norms (WHO, 1987, 1992, 1999).

Assessment of semen quality is based on the evaluation of several parameters, including semen volume, sperm count, sperm motility and sperm morphology. It is now accepted that these parameters can be influenced by many factors such as smoking (Kunzle et al., 2003). Despite worldwide ant-smoking campaigns, cigarette is very common. Some studies have reported that the association between man smoking and semen quality was stronger in healthy men than in the infertile population (Zimaman et al., 2000). The negative effects of smoking on general health are well known, but smoking may also affect fertility (Mehranian 2007).

A study by Karagounics and Co-workers (1985) revealed that smoking impaired sperm motility, reduced sperm lifespan and caused changes that affect the offspring. Gaur et al., 2007 demonstrated that men who smoke had lower sex drives and less frequent sex. Tooba 2007 reported that the semen parameters were much lower in the smokers than in the non-smokers. All these results indicate that cigarette smoke contains a lot of known toxins, which may have detrimental effects on fertility, but they did not mention the effect of cigarette smoking between fertile and infertile men. Therefore this study was designed to determine the prevalence of infertility among the obese couples and to correlate body weight in male with infertility related parameters

II. MATERIALS AND METHODS:

A. Population and collection of data:

Total of (496) fertile and infertile men were included in this study between Sep 2006 and Dec 200. The data of this study was collected through interviewing of the fertile and infertile men during their first and second visit in infertility clinic and IVF center in Pediatric and Rizgary Laboratory Hospital in Erbil City, Iraq. In this study men who smoke less than 10 cigarettes were considered as a mild smokers, 10-20 as intermediate smokers and more than 20 cigarette as heavy smokers. The amount of body fat was assessed clinically using the BMI formula by Cole et al., (1995).

B. Semen Collection and semen parameters:

The procedures for semen collection after 3-5 days of sex abstinence are based on WHO recommendations (WHO, 1987, 1992 and 1999).

Semen volume, sperm liquefaction, sperm motility, sperm concentration and sperm count were done within 30-60 minutes

of 37 incubated semen based on normal range of WHO recommendations: volume= 2-6 ml, liquefaction= < 60 min, sperm concentration= 20 million sperms/ml or more, sperm count= 50% or more with forward progression and 25% or more with rapid progression within 60 minutes and morphology= 30% or more with normal forms (WHO, 1987, 1992 and 1999).

C. Preparation of sperms for eosin – nigrosine staining:

Human semen samples were obtained from fertile and infertile men with or without obesity according to WHO 1987 after 2 – 3 days of sexual abstinence. The method of Jaiswal et al., 1999 was applied with some modification. Following incubation the supernatants containing sperms for each condition (infertile smokers and non-smokers, fertile smokers and non-smokers) were divided into a three aliquots (at least 50 ul for each).

III. RESULTS

In this study, the number of fertile smokers was 203. This number was distributed into five groups BMI. The number of each group was (31, 118, 40, 8 and 5), respectively., while the number of infertile non-smokers was 78. Similar to smokers, this number was also divided into five groups according to their BMI. The number of each group was (15, 44, 10, 4 and 5), respectively. The infertile smokers were 147, each group BMI includes (25, 57, 33, 15 and 17), respectively, while the number of infertile non-smokers was 68. The numbers were (18, 18, 15, 9 and 8), respectively.

Regarding semen parameters, Table (1) shows no significant differences between smoker and non-smoker men with regard to semen liquefaction.

Statistical analysis showed significant differences between smokers and non-smokers men in regarding to sperm count. The highest sperm count was observed in the first group BMI in fertile non-smoker men with mean value (68.9 +_3.7) as illustrated in Table 2.

Table (3) shows non-significant differences between smoker and non-smoker men with regard to semen volume.

Concerning the sperm motility, Table (4) shows significant differences of active sperm between smoker and non-smoker men with p-value=0.001. the interaction shows significant differences between all BMI of fertile and infertile smoker. The highest mean value of active sperm was mainly at first group of BMI of fertile non-smoker (67.39+_3.1), while the lowest value mean was seen in the last group BMI of infertile smoker with mean value (21.42+_3.4). Table (5) demonstrates no significant differences between smoker and non-smoker men with regard to sluggish sperm (p-value= 0.629). the lowest mean value was mainly found in the first group BMI in fertile non-smoker (6.81+_1.8). Table (6) shows no significant differences between smoker and non-smoker men with regard to immotile sperm (p value= 0.916). The current results showed that there were significant differences between groups in interaction with p – value= 0.000. the highest value of immotile sperm was found in fourth group BMI of infertile smokers (42.14+_6.24), while most of the other groups in the interaction were non-significant.

In this study, statistical analysis recorded significant differences between smoker and non-smoker men with regard to normal sperm morphology (p-value= 0.00) as shown in Table (7). The results of interaction revealed that there were significant differences between groups with p= 0.000. Moreover, the current results also showed significant differences between smoker and non-smoker men in regarding to abnormal morphology with p-value=0.000 as shown in Table (8). the interaction shows significant differences between BMI groups in different infertile and fertile men (p=0.05). there were no significant differences between infertile BMI groups in smoker and non-smoker. The highest value were recorded in third group BMI of infertile smoker and fourth group BMI of infertile non-smoker with mean value (74.09+_1.55) and (74.09+_1.93), respectively.

Condition	Non-smoker		Smoker		mean BMI	P value = 0.042
	Infertile	Fertile	Infertile	Fertile		
18-24.9	26.86±0.74*	23.33±1.05*	24.47±1.7*	25.45±1.2*	25.03±0.61*	
25-29.9	23.19±0.51*	23.99±0.8*	26±0.67**	26.57±1.0**	24.94±0.4*	
30-34.9	25.35±0.8**	23.66±1*	25±2.13**	23±2.21**	23.75±0.76*	
35-39.9	23.13±2.66*	22.5±1.72**	25±2.04**	22.73±2.6**	23.34±1.14**	
> 40	23±2*	20.95±1.41*	25±2.89**	20.45±1.96*	22.35±1.28*	
Mean						
Condition	24.31±0.77*	22.89±0.53*	25.09±1.07*	23.24±0.74*		P value = 0.04
Mean						
Smoking	23.6±0.47		24.17±0.65			P value = 0.477
						P value = 0.007

Table 1: The Mean (±S.E) of the effects of cigarette smoking on the sperm liquefaction of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences±.

Condition	Non-smoker		Smoker		mean BMI	P value = 0.008
	Infertile	Fertile	Infertile	Fertile		
18-24.9	15.7±5.94e	68.9±3.7e	14±2.31e	50.2±2.87cd	37.4±2.12 d	
25-29.9	11.3±3.9e	68.4±2.14e	11.5±3.14e	51.1±4.0cd	37.6±1.43d	
30-34.9	11.4±7.02e	64.1±2.46e	9.15±3.06e	47.9±2.4bcd	33.1±2.4c	
35-39.9	11.6±6.41e	50.3±7.9ade	10.6±3.24e	42.1±3.3bc	30.6±3.17 b	
> 40	11.8±.78e	43.7±9.4bcd	7.26±3.48e	33.7±7.23c	25.1±5.69 b	
Mean						
Fertility	12.2±2.34e	61.6±3.04b	10.6±1.71e	45.1±2.09 b		P value = 0.000
Mean						
Smoking	36.9±11.95 b		27.22±11.33 b			P value = 0.000
						P value = 0.00

Table 2: The Mean (±S.E) of the effects of cigarette smoking on the sperm count of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant difference.
- * Different letters means significant differences.

Condition	Non-smoker		Smoker		mean BMI	P value = 0.05
	Infertile	Fertile	Infertile	Fertile		
18-24.9	1.79±0.11abc	1.95±0.1abode	2.61±0.1defg	2.81±0.1g	2.28±0.07b	
25-29.9	1.64±0.11a	1.93±0.1abode	2.61±0.1defg	2.47±0.1bcdef	2.16±0.04ab	
30-34.9	1.80±0.21abcd	1.95±0.1abode	2.66±0.2efg	2.57±0.1defg	2.25±0.06ab	
35-39.9	1.63±0.12a	1.86±0.1abode	2.79±0.3efg	2.38±0.3defg	2.16±0.14ab	
>40	1.77±0.1abc	1.75±0.09ab	2.53±0.1cdefg	2.06±0.1abode	2.02±0.16a	
Mean						P value=0.00
Fertility	1.73±0.09a	2.64±0.13b	1.89±0.06a	2.46±0.08b		
Mean Smoking		2.18±0.06		2.17±0.05		
						P value = 0.000

Table 3: The Mean (±S.E) of the effects of cigarette smoking on the sperm volume of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences±

Condition	Non-smoker		Smoker		mean BMI	P value = 0.0262
	Infertile	Fertile	Infertile	Fertile		
18-24.9	31.25±5.96ab	67.22±5.6d	27.38±3.7cd	68.72±5.1ab	48.64±3.3b	
25-29.9	25.15±3.0a	65.76±1.9d	30.15±5.5abc	62.43±2.9ab	45.81±2.2b	
30-34.9	27.51±5.89ab	67.83±3.1d	25.51±2.4ab	50.18±3.3a	42.26±3.46b	
35-39.9	25.15±2.5a	57.62±4.7d	25.21±3.6ab	50.33±3.9a	39.04±4.45a	
>40	23.33±4.25a	58.13±3.8d	21.42±3.4ab	50.14±6a	38.19±4.32a	
Mean						P value=0.000
fertility	26.41±2.1b	63.28±4.37a	25.10±2.7b	54.33±4.16a		
Mean Smoking		44.21±0.02a		39.95±1.71b		
						P value = 0.000

Table 4: The Mean (S.E) of the effects of cigarette smoking on the active sperm of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences.

Condition	Non-smoker		Smoker		mean BMI	P value = 0.000
	Infertile	Fertile	Infertile	Fertile		
18-24.9	21.26±11.6ade	6.21±11.2a	17.63±9.7ade	9.43±6.2ab	13.26±11.17a	
25-29.9	22.43±9.30ef	17.44±1.9ade	21.67±9.9ade	10.71±11.2abc	12.09±10.77b	
30-34.9	22.51±12.1def	12.22±2ade	21.73±2.6ade	11.71±7.9abc	12.44±11.47b	
35-39.9	22.63±2.9ef	12.91±2ade	22.12±0.4ef	20.91±5.2ade	22.62±2.12b	
>40	22.11±2.2ef	22.52±2.7ef	33.33±3.22f	27.73±3.2ef	22.57±2.44c	
Mean						P value=0.000
Condition	24.08±11.47b	17.28±11.02a	23.91±2.1b	16.11±4a		
Mean Smoking		20.68±0.9		19.91±1.3		
						P value = 0.000

Table 5: The Mean (±S.E) of the effects of cigarette smoking on the sluggish sperm of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences.

Condition	Non-smoker		Smoker		mean BMI	P value = 0.034
	Infertile	Fertile	Infertile	Fertile		
18-24.9	30.34±3.2abcd	17.11±3.1abcd	25.28±6.0ab	15.45±2abcd	22.05±2.03a	
25-29.9	31.85±1.9abcd	18.46±1.25a	36.21±2.68b	15.41±2.3abcd	25.48±1.33ab	
30-34.9	34.48±3.4abcd	17.73±2.07a	31.22±3.5ab	21.51±1.8abcd	26.23±2.51ab	
35-39.9	33.75±7.2abcd	22.51±2.5abcd	42.14±6.24d	22.73±3.1abcd	30.28±3.79b	
>40	35.19±7.5abcd	30.11±7abcd	39.11±3.4c	25.12±2abcd	32.27±4.25b	
Mean						P value=0.000
Condition	33.08±2.55b	21.16±3.56a	34.79±1.77b	20.02±2.46a		
Mean Smoking		27.12±2.19		27.41±1.52		
						P value = 0.000

Table 6: The Mean (±S.E) of the effects of cigarette smoking on the immotile sperm of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences

Condition	Non-smoker		Smoker		mean BMI	P value = 0.01
	Infertile	Fertile	Infertile	Fertile		
18-24.9	36.05±2.55ab	69.57±2.02c	37.95±2.7ab	72.08±1.65c	53.92±1.43b	
25-29.9	31.74±1.48ab	66.99±1.06c	35.2±9.3a	62.09±2.19c	48.95±0.94b	
30-34.9	25.91±3.56a	67.41±1.27c	32.2±2.6a	61.95±2.29c	46.81±1.77b	
35-39.9	30±2.04a	63.75±5.49c	25.91±3.3a	46.79±2.32b	41.61±2.66a	
>40	30±2.89a	65±4.18c	29.55±2.65a	37.86±3.49ab	40.6±2.98a	
Mean						P value=0.000
Condition	30.74±2.51a	66.54±1.8b	32.08±1.73a	56.15±1.25b		
Mean Smoking		48.64±1.54b		44.12±1.07a		
						P value = 0.000

Table 7: The Mean± (S.E) of the effects of cigarette smoking on the normal sperm morphology of the both fertile and infertile men regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences±

Condition	Non-smoker		Smoker		mean BMI	P value = 0.019
	Infertile	Fertile	Infertile	Fertile		
18-24.9	30.43±0.65c	63.95±1.89ab	27.92±3.18c	62.04±1.65ab	46.08±0.43a	
25-29.9	33.01±1.19c	68.26±2.25a	37.91±0.8c	65±0.73ab	51.05±0.1ab	
30-34.9	32.6±1.29c	74.09±1.55a	38.05±0.54c	68±1.71a	53.19±0.77b	
35-39.9	36.25±1.32c	70±2.48a	53.21±1.02b	74.09±1.93a	58.39±1.66b	
>40	35±3.49c	70±2.56a	62.14±0.06ab	70.45±1.6a	59.4±1.98b	
Mean						P value=0.000
Condition	33.46±1.51a	69.26±0.27b	43.85±1.04a	67.918±2.36b		
Mean Smoking		51.36±0.07a		55.88±2.49b		
						P value = 0.05

Table 8: The Mean (±S.E) of the effects of cigarette smoking on the abnormal sperm morphology of the both fertile and infertile men in regarding the BMI.

- * Same letters means no significant differences.
- * Different letters means significant differences

IV. DISCUSSION

Concerning the Relation between BMI and semen parameters, the results of this study showed that there are positive relation between BMI and the time of liquefaction. These results are in agreement with the study of Hilton et al., 2005. The evaluation of semen liquefaction time may be related to disturbance happened because of hormonal abnormalities in obese persons (Ahmad et al., 2006).

The results also showed That BMI is associated with sperm count. This explains the negative relation between BMI and sperm concentrations. It has been documented that obese males usually express a characteristic hormonal profile described as hypogonadotrophic hyperestrogenic hypogonadism (Liu and Handelsman, 2003). In this study the semen volume decreased as the BMI increased . this result is supported by Chavarro et al., 2009 who concluded that the ejaculated volume decreased steadily with increasing BMI levels. The mechanism may be due to the reduction in testosterone and also erectile dysfunction (Stewart et al., 2009).

The current results also showed that active sperms were less at the higher BMI groups, while sluggish sperms were higher in obese cases. The results are in agreement with Hofny et al., 2009 who suggested that reduction of sperm motility in overweight cases may be due to the decreasing of the action of testosterone and enhancing the action of estradiol (Sutz et al., 2004).

Moreover, the results of this study showed a positive relation between high BMI groups and high abnormal sperm morphology. Similar results were revealed by Hilton et al., 2005). This might be due to the stimulation of oxidative stress by obesity as adipose tissue releases pro-inflammatory cytokines that increase leukocyte production. Furthermore, it has been found that prostatic and seminal fluid infections may lead to sperm morphology abnormalities, dysfunction of sperms and changes in semen parameters (Giblin et al., 1988).

Regarding the influence of cigarette smoking on semen parameters, the results of the current study showed that smoking significantly reduce the liquefy time. This might suggests that cigarette smoke contains a lot of known toxins, which may have detrimental effects on every sperm parameters including time of liquefaction. Simply stop smoking could prevent the toxins contained in cigarette smoke (Augood et al., 1998).

Concerning the cigarette, the results showed significant influence of smoking on sperm count. This finding supported by the results of (Martin-Du and Bourrit 1999; Elshal., 2009). Smoke acts on sperm numbers and functions as demonstrate by many authors, even though the mechanism is not fully understood because of the various actions of toxin chemicals on the process of spermatogenesis through free radical production or through alteration of hormonal regulation (Augood et al., 1998 and Sepaniak., 2006).

In this study the semen volume was much lower in the smokers than in the non-smokers and was much lower in the non-smokers of infertile men than in the fertile men. These results are agreed with that demonstrated by Mehrannia 2007 and Gaur et al., 2007. These results can be explained that chemical agents or mutagens may affect male reproduction via

direct effect on the testes and their ability to produce sperms via the process known as ospermatogenesis.

Concerning the influence of smoking on sperm motility, the present results recorded a significant influence on the percentage of active sperms. Similar results were found by Zampreri et al., 2008 who concluded that cigarette smokers and drinkers of alcohol have lower semen volume and sperm motility comparing with non-smokers and drinkers.

In this study, the semen of non-smokers either fertile or infertile men shows less abnormal sperm morphology than smokers. Although there is some evidence to the contrary, a number of studies have shown higher incidences of abnormality shaped sperm cells as well as decreased motility and sperm concentration in men who smoke (Augood et al., 1998).

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