Original Research

The Relationship Between BMI and Spermogram Indices in Male Iranians Aged 20 to 50 Years Old

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Abstract: **Introduction:** Male factor infertility is the cause of 20 to 30% of infertile couples in population, and there are reports that obesity in men may be one of the factors affecting fertility. Accordingly, this study aimed to examine the relationship between Body Mass Index (BMI) and semen parameters in 20 to 50 year-old Iranian men.

Materials and Methods: The archives of two major laboratories in Tehran were screened and the results of semen analyses from 640 nonvasectomized men referring during 2009-2013 were collected. Data on height, weight, BMI, age, sperm count, percentage of sperm motility, normal sperm morphology, and sperm viability was recorded. Anal-ysis of these data was performed using SPSS software.

Results: The mean age of subjects and their mean BMI were 30.2 ± 5.9 years and 26.0 ± 4.1 kg/m2, respectively. The average values of semen parameters were as follows: total sperm count = 53.7 ± 33.6 million, pH = 8.2 ± 0.3, normal sperm morphology = 50.1 ± 10.9%, viability = 69.46 ± 12.6%, and grade-A sperms = 39.4 ± 16.8%. BMI had no significant correlation with the semen parameters including sperm morphology, viability, pH, and motility.

Conclusion: No significant correlation between BMI and semen parameters was observed in the sample of Iranian males evaluated in this study.

Keyword: Body Mass Index; Semen Analysis; Sperm Count

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1. Introduction

In recent years, overweight and obesity are becoming public health issues in different societies.(1) Infertility is also another public problem threatening families' stability and imposing a great burden on the society.(2) Infertility assessment plays an important role in detection and treatment of possible causative factors and gives couples with untreatable conditions the chance to pursue in vitro fertilization methods without wasting any more time.(3) According to current evidence, obesity makes considerable alterations in hormonal interactions and their levels in the body and can affect fertility of the person as well. These effects have been evaluated in women's populations to a greater extent (1,4) and it has been shown that women with high BMIs (> 25 kg/m2) are more at risk of ovulation disturbances and infertility, compared to others. (5)

Semen analysis is the first step and the most important one in infertility assessment, (6,7) but little information is available on the correlations between BMI and male factor infertility and semen parameters. (1) It is believed that overweight and obesity is associated with alterations in hormonal profile in men. Higher BMIs have also been shown to correlate with changes in the serum

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levels of estrogen, progesterone and also the sex hormone binding globulin (SHBG). (8) However, the effects of these hormonal changes on male fertility is still not clear. (1)

Recently, some studies have evaluated the relation between BMI and semen analysis parameters in different populations; however, they all have included patients referring to their clinics with complaint of infertility. Accordingly, the present study included 20 to 50 year-old nonvasectomized men who had referred to laboratories for semen analysis due to various reasons. With inclusion of healthy subjects in the present study, we aimed to yield results that are more reliable and generalizable to the whole population. Detection of this treatable cause of infertility in men could be of great value in decreasing the prevalence of this social problem.

2. Method

In this analytical cross sectional study, the target population was 20 to 50 year-old nonvasectomized men refer-ring to either the laboratory of Rasul Akram Hospital or a credible private laboratory in Tehran during 2009-2013 for semen analysis. Both of these laboratories had internal quality control programs, in which they randomly re-evaluated a few of the specimens they received and double checked their results to make sure of their accuracy.

So the inclusion criteria were considered as nonvasectomized individuals aged 20-50 years old referring for se-

Table 1: Descriptive results of demographic and semen analysis data in the sample population.

Parameter	Number of subjects	Minimum	Maximum
Age, years	640	20	50
Height, (cm)	640	148	198
Weight, (kg)	640	40	165
BMI, (kg/m2)	640	15.6	49.3
Sperm count (×106)	640	2	175
pH	637	7.5	9
Normal morphology, (%)	629	25	80
Viability, (%)	525	38	99
Motility at 30 minutes, (%)	574	40	95
Motility at 60 minutes, (%)	598	20	90
Motility at 120 minutes, (%)	639	0	85
Motility at 180 minutes, (%)	635	0	80
Grade A, (%)	640	5	100
Grade B, (%)	640	0	65
Grade C, (%)	640	0	85
Grade D, (%)	640	0	70

BMI, Body Mass Index.

Table 2: The results of semen analysis based on BMI groups of participants.

Parameter	**Mean values in each BMI group**				
	Less than 18.5 (n=13)	**18.5-25 (n=254)**	**25-30 (n=204)**	**30-35 (n=151)**	**Greater than 35 (n=18)**
Sperm count (×106)	62.5	70.8	72.6	72.5	67.2
pH	8.1	8.2	8.2	8.2	8.1
Normal morphology, (%)	48.0	49.3	50.7	50.9	51.6
Viability, (%)	68.3	69.0	70.8	68.8	68.5
Motility at 30 minutes, (%)	62.5	64.9	64.4	63.7	65.9
Motility at 60 minutes, (%)	51.5	55.3	55.3	53.4	58.2
Motility at 120 minutes, (%)	42.3	43.9	42.2	41.4	46.9
Motility at 180 minutes, (%)	31.9	34.1	32.4	31.3	38.6
Grade A, (%)	39.2	39.0	39.6	40.7	34.4
Grade B, (%)	9.2	8.4	8.2	8.1	8.9
Grade C, (%)	35.0	39.4	39.8	39.4	46.4
Grade D, (%)	15.8	13.0	12.5	11.7	10.3

BMI, Body Mass Index.

men analysis due to various reasons, whose results were found to be normal Census method was used for inclusion of participants through screening of the archives of the two laboratories with a sample size of 640 subjects. Data were extracted from the medical records of subjects eligible to be included in the study.

Evaluated variables included: age, height, weight, BMI, sperm count, percentage of sperm motility, normal morphology and sperm viability. Extracted data were record-ed in predesigned checklists and eventually were entered into SPSS software for windows v.22 (IBM Corp., Armonk, NY) (9) for analysis. Type I error (α) was set as 5%. Descriptive statistics were presented as mean and standard deviation for quantitative variables and frequency and percentage for qualitative ones. Data were tested for normality using the Shapiro-Wilk test. Linear regression analysis was used to determine the relation between BMI of the subjects with the spermogram indices in the whole sample population and each of the age groups separately. Independent samples t-test was also used to compare the values of spermogram indices between BMI groups of less and higher than 25 kg/m2, and less and higher than 30 kg/m2.

3. Result

A total of 640 nonvasectomized men referring to two credible laboratories in Tehran for semen analysis were included as the sample population. The mean age of these subjects was calculated to be 30.2 ± 5.9 years, 389 (59.7%) were in the age group of 20-30, 219 (34.2%) were aged 31-40 and 39 (6.1%) were aged 41-50 years

Table 3: The results of semen analysis based on age groups of participants.

Parameter	Mean values in each BMI group		
	20-30 years old	31-40 years old	41-50 years old
Sperm count (×106)	71.2	71.9	36.7
pH	8.2	8.2	8.2
Normal morphology, (%)	50.2	49.7	51.9
Viability, (%)	69.3	70.3	66.4
Motility at 30 minutes, (%)	64.2	63.8	64.7
Motility at 60 minutes, (%)	55.0	54.5	55.3
Motility at 120 minutes, (%)	43.6	41.9	40.5
Motility at 180 minutes, (%)	33.6	32.1	31.2
Grade A, (%)	38.9	39.7	43.1
Grade B, (%)	8.1	8.6	8.3
Grade C, (%)	40.2	38.7	39.9
Grade D, (%)	12.7	12.8	9.0

BMI, Body Mass Index.

Table 4: The p value calculated for each of the evaluated correlations between BMI and spermogram indices according to the participants' age groups, using linear regression analysis.

Parameter	All age groups	Mean values in each BMI group		
		20-30 years old	31-40 years old	41-50 years old
Sperm count (×106)	0.51	0.68	0.54	0.48
pH	0.64	0.57	0.81	0.44
Normal morphology, (%)	0.24	0.36	0.60	0.27
Viability, (%)	0.43	0.55	0.71	0.66
Motility at 30 minutes, (%)	0.38	0.47	0.59	0.51
Motility at 60 minutes, (%)	0.18	0.29	0.03	0.33
Motility at 120 minutes, (%)	0.55	0.75	0.48	0.37
Motility at 180 minutes, (%)	0.67	0.88	0.76	0.64
Grade A, (%)	0.76	0.46	0.83	0.57
Grade B, (%)	0.64	0.39	0.69	0.74
Grade C, (%)	0.28	0.16	0.34	0.22
Grade D, (%)	0.52	0.85	0.46	0.71

BMI, Body Mass Index.

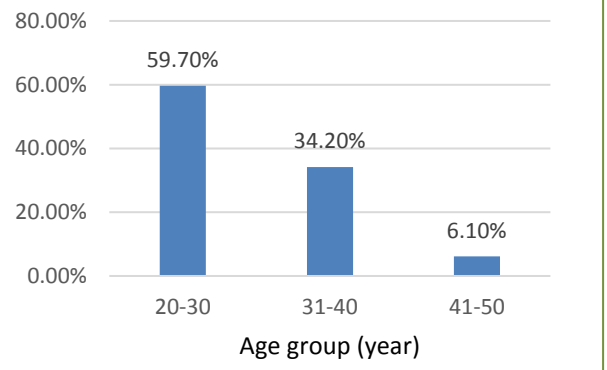

Figure 1. Distribution of sample population regarding their age groups.

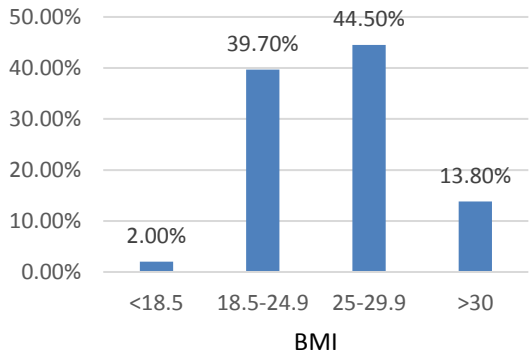

Figure 2. Distribution of sample population regarding their BMI groups.

old.

The average height was 175.8 ± 7.2 cm (ranging from 148 to 198 cm), the average weight was 80.5 ± 14.3 kg (40-165 kg) and the mean of BMI was calculated to be 26.0 ± 4.1 kg/m2 (ranging from 15.6 to 49.3 kg/m2). The majority of participant (86.2%) had BMIs within the range of 18.5 to 28 kg/m2 (Figure 1).

Table 1 presents the semen analysis parameters in the sample population. BMI had no significant correlation with any of the spermogram indices including sperm count, pH, percentage of sperms with normal morphology, percentage of viability, motility at 30 minutes and one hour after ejaculation and also percentage of sperms with Grade A, B, C and D motilities ($p > .05$).

Even within different age groups, BMI showed no significant correlation with spermogram parameters ($p > .05$). Only in the 31 to 40 age group, BMI was negatively correlated with the percentage of sperm motility at 60 minutes after ejaculation in a way that increased BMIs were associated with decreased motility of the sperms at one hour after ejaculation ($R = -0.14$, $p = .03$). Table 3 presents the values of spermogram indices according to the participants' age groups and the p value calculated for each of the evaluated correlations are presented in Table 4.

Further analyses were performed via independent samples t-test, evaluating the correlations between two dichotomous variables of normal BMI (cutoff value set as BMI = 25 kg/m2) and obesity (cutoff value set as BMI = 30 kg/m2) with spermogram indices, the results of which showed no significant correlations between neither of the two groups and the evaluated parameters ($p > 0.05$).

4. Discussion

Overweight and obesity are believed to negatively affect fertility. Its effects on insulin resistance and androgen binding could alter fertility in women. Some epidemiological studies have also been conducted on the relation between semen quality and BMI in fertile men. (10) The present study was implemented on 640 nonvasectomized men aged 20 to 50 years old to assess the correlation between BMI and semen parameters.

The average BMI in the sample population was 26.0 ± 4.1 kg/m2 with the majority of subjects (86.2%) in the normal to overweight range (18.5-28 kg/m2). The average values of semen parameters were as follows: total sperm count = 53.7 ± 33.6 million, pH = 8.2 ± 0.3, normal sperm morphology = 50.1 ± 10.9%, viability = 69.46 ± 12.6%, and grade-A sperms = 39.4 ± 16.8%. All these figures were within the normal ranges established by the World Health Organization (WHO). (11)

Based on the results of this study, BMI had no significant correlation with any of the spermogram indices including sperm count, pH, percentage of sperms with normal morphology, percentage of viability, motility at 30 minutes and one hour after ejaculation and also percentage of sperms with Grade A, B, C and D motilities. In a similar robust study by Aggerholm et al. overweight and obesity were reported to affect the profile of sex hormones in male subjects, but no significant changes in the semen quality were observed.(12) In the study conducted by Nicopoulou et al. in 2009, also no significant relation was found between BMI and sperm count in men.(13) In another study in 2004, Jensen et al. found no correlation between BMI and the percentage of motile sperms, their morphology and semen volume as well.(14)

However, in 2017, Qin et al. reported a significant correlation between BMI and sperm count with higher BMIs having protective effects against low sperm counts. (10) Although in their linear regression correlation analysis BMI and sperm count showed a positive correlation, but when the subjects were categorized into different groups regarding their BMIs, there were no significant differences in semen parameters between these groups. (10)

On the other hand, some studies including Hammoud et al.'s reported higher incidence of oligospermia and percentage of sperms with lack of progressive motility with increase BMI in men. (4)

In the present study the age of participants did not have a significant correlation with semen parameters either, while in the study conducted by Koloszar et al. the sperm count showed a steady decline with increasing age in obese subjects (BMI > 30 kg/m2). (15) According to Xu et al. in 2011, sperm motility and progressive motility were found to decrease with aging and the incidence of oligospermia was reported to be higher in older subjects. (16)

One of the main reasons that we did not find a significant correlation between age and semen parameters in the present study was our sample population who were included from a specific age range (20 to 50 years old) and most of them (93.9%) were younger than 40 years old. Hence, assessment of this correlation might have yielded incongruent results in the limited age group evaluated.

In the study conducted in 2009 in Hamedan, Bab Alhavaeji et al. evaluated 350 couples with infertility, most of which were obese. Subjects with normal BMIs in their sample population were found to have higher sperm counts compared to participants with higher or lower BMIs; however, no significant association was reported between BMI and semen parameters namely the sperm count, motility, percentage of normal morphology and sperm density in infertile men. (2)

One of the limitations of the present study is that the semen analyses performed in the two laboratories could be the subject of inter and intra-observer's variability. Another limitation was that considering the retrospective setting of the study, the majority of data on the clinical and socio-demographic status of the subjects were missing and could not be included in the analyses.

5. Conclusion:

The findings of the present study showed no significant correlation between BMI and neither of the spermogram indices including morphology, viability, pH and motility. Moreover, there was no significant correlation between age and semen parameters in 20 to 50 year-old men.

6. Acknowledgment

None.

7. Conflict of interest:

All authors declare that there is no conflict of interest in this study.

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9. Author's contributions:

All the authors have contributed to drafting/revising the manuscript, study concept, or design, as well as data col-lection and interpretation.

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