ORIGINAL PAPER

Investigation of the effect of body mass index (BMI) on semen parameters and male reproductive system hormones

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__Summary__ *Aim: To evaluate the effects of body mass index (BMI) ratio on semen parameters and serum reproductive hormones.*
Materials and methods: The data of 454 patients who prsented to male infertility clinics in our hospital between 2014 and 2015 were analyzed retrospectively. Weight, height, serum hormone levels and semen analysis results of the patients were obtained. BMI values were calculated by using the weight and height values of the patients and they were classified as group 1 for BMI values ≤ 25 kg/m², as group 2 for BMI values 25-30 kg/m² and as group 3 for BMI values ≥ 30 kg/m².
Results: The mean values of BMI, semen volume, concentration, total motility, progressive motility, total progressive motile sperm count (TPMSC), normal morphology according to Kruger, head abnormality, neck abnormality, tail abnormality, FSH, LH, prolactin, T/E2, total testosterone and estradiol parameters of the patients were considered.
Patients were divided according to BMI values in Group 1 (n = 165), Group 2 (n = 222) and Group 3 (n = 56).
There was no statistically significant difference in terms of all variables between the groups.
Conclusions: We analyzed the relationship between BMI level and semen parameters and reproductive hormones, demonstrating no relationship between BMI and semen parameters. In our study, BMI does not affect semen parameters although it shows negative correlation with prolactin and testosterone levels.

KEY WORDS: *Infertility; BMI; Semen parameters; Reproductive hormones.*

INTRODUCTION

Being overweight and obesity are among the most significant health problems in our era. *World Health Organization* (WHO) described as overweight a patient with *body mass index* (BMI) ≥ 25 kg/m² and as obese a patient with BMI ≥ 30 kg/m. According to WHO data, 35% of the young patients, who are in their twenties, are overweight and 11% of them are obese (1). It was reported that the overweight and obesity incidence dramatically increased in developed countries in last 30 years (2).
Infertility is another health problem affecting 15% of the couples in developed countries (3). A significant decrease in the sperm quality was shown by studies conducted in last 25 years (4, 5). The reason of this decrease aroused interest and it became a subject for research. Especially, its relation with the obesity was analyzed in a

number of studies and in some studies this decrease was found as associated to the increase in obesity prevalence (2). But, there is not a consensus in the literature and contradictory results were published. In this study, we analyzed the effect of BMI on semen parameters and the relationship with reproductive hormone levels.

MATERIALS AND METHODS

The data of 454 patients who presented to male infertility clinics in our hospital between 2014 and 2015 were analyzed retrospectively. Weight, height, serum hormone levels and semen analysis results of the patients were considered. BMI values were calculated by using the weight and height values of the patients and they were classified as Group 1 for BMI values ≤ 25 kg/m², as Group 2 for BMI values 25-30 kg/m² and as Group 3 for BMI values ≥ 30 kg/m².
Semen analysis was performed after a 3-5 days of sexual abstinence. Semen analysis was performed according to WHO 2010 criteria (semen volume ≥ 1.5 ml; sperm concentration ≥ 15 × 106/ml; total motility ≥ 40%, progressive motility ≥ 32% and morphology ≥ 4%). After 5-30 minutes of sample collection, the analysis was performed after the sample was liquefied. For the microscopic examination in semen analysis, phase contrast light microscope was used and the examination was performed with 10 x 20 magnification. For sperm concentration, *Makler* counting chamber was used and the sperm count (concentration) was found in million/ml with the sperm count in 10 squares in a 100 square area. Motility was evaluated in 3 Groups as linear progressive motility, non-progressive motility and immotility. For the morphological examination, semen sample which was dropped on slides, washed with 70% alcohol previously, according to sperm concentration were dried with 45 degrees angle. Then, it was stained with Diff-Quick kit and at least 200 sperm were analyzed under immersion oil with 100X objective and the percentage of the sperm having normal morphology was determined.
For the hormone levels, blood sample was collected in the morning before 10.00 a.m. Hormone analysis was performed with *Roche Hitachi Cobase 601 equipment* and by using microparticle enzyme immunoassay method. FSH, LH, prolactin, total testosterone and estradiol levels were analyzed. The statistical analysis was performed with IBM *Statistical Package for Social Sciences* (SPSS) Version 22.0

No conflict of interest declared.

Parameter	BMI			p value
	< 25.0 kg/m²	25.0-30.0 kg/m²	> 30.0 kg/m²	
BMI (kg/m²)				
Minimum	18.78	25.01	30.04	
Maximum	24.98	29.98	43.55	
Mean	22.65	27.06	33.09	
Std. Dev.	1.69	1.35	3.44	
Volume (mL)				0.330
Minimum	0	0	0	
Maximum	11	8	8	
Mean	2.88	2.69	2.58	
Std. Dev.	1.71	1.67	1.65	
Concentration (10⁶/mL)				0.576
Minimum	0	0	0	
Maximum	168	170	140	
Mean	33.28	35.56	33.74	
Std. Dev.	36.91	36.29	35.59	
Total motility (%)				0.754
Minimum	0	0	0	
Maximum	85	85	90	
Mean	46.34	49.76	47.63	
Std. Dev.	25.29	22.22	27.26	
Progressive motility (%)				0.694
Minimum	0	0	0	
Maximum	80	94	80	
Mean	30.15	31.94	30.66	
Std. Dev.	21.89	21.55	22.91	
TPMSC (Million)				0.790
Minimum	0	0	0	
Maximum	352.8	361.08	220	
Mean	40.66	44.40	41.97	
Std. Dev.	59.97	62.83	56.67	
Normal morphology (Kruger) (%)				0.554
Minimum	0	0	0	
Maximum	10	9	7	
Mean	2.43	2.60	2.26	
Std. Dev.	2.23	2.12	2.00	
Head abnormality (%)				1.000
Minimum	0	0	0	
Maximum	100	91	86	
Mean	50.16	51.75	48.20	
Std. Dev.	39.93	38.41	40.82	
Neck abnormality (%)				0.937
Minimum	0	0	0	
Maximum	14	14	14	
Mean	5.72	6.15	6	
Std. Dev.	5.12	4.89	5.29	
Tail abnormality (%)				0.561
Minimum	0	0	0	
Maximum	11	13	14	
Mean	4.16	4.66	3.80	
Std. Dev.	3.86	3.94	4.02	
FSH (mIU/mL)				0.299
Minimum	1.56	1.57	1.68	
Maximum	31	44.72	17.15	
Mean	3.42	2.76	2.18	
Std. Dev.	5.58	2.18	3.74	
LH (mIU/mL)				0.452
Minimum	2	1.63	2.02	
Maximum	14.63	19.57	16.87	
Mean	5.61	5.29	6.04	
Std. Dev.	2.74	5.72	3.22	
Prolactin (ng/mL)				0.018
Minimum	3.35	2.98	5.83	
Maximum	27.85	49.29	27.04	
Mean	11.44	9.87	10.88	
Std. Dev.	5.51	5.84	4.37	
T/E ratio (%)				0.815
Minimum	6.98	2.05	8.31	
Maximum	22.16	39.13	14.87	
Mean	11.82	15.49	11.59	
Std. Dev.	8.26	9.77	4.63	
Testosterone (ng/dL)				0.001
Minimum	9.1	4.31	147.10	
Maximum	851.7	856	676.20	
Mean	488.32	398.20	377.61	
Std. Dev.	175.13	139.71	113.36	
Estradiol (pg/mL)				0.270
Minimum	16.32	7.21	32.76	
Maximum	44.24	160.30	57.29	
Mean	29.88	34.93	45.02	
Std. Dev.	9.87	37.12	17.34	

Table 1.
Mean volues of data and p values according to BMI groups.

programme. A value of $p < 0.05$ was accepted as statistically significant.

RESULTS

The mean values of BMI, semen volume, concentration, total motility, progressive motility, *total progressive motile sperm count* (TPMSC), normal morphology according to *Kruger*, head abnormality, neck abnormality, tail abnormality, FSH, LH, prolactin, T/E2, total testosterone and estradiol parameters of the patients are shown in Table 1. Patients were divided according to BMI values in Group 1 (n = 165), Group 2 (n = 222) and Group 3 (n = 56). There was no statistically significant difference in semen parameters between the groups. BMI ratio do not affect semen parameters but it shows negative correlation with prolactin and total testosterone.

DISCUSSION

The effect of obesity on semen parameters is multifactorial and it was tried to be explained with different pathophysiological mechanisms (6, 7).
The fact that testosterone is aromatized to estradiol (E2) in fat tissue (8), the decrease in *sex hormone binding globulin* (SHBG) levels (9), the suppression of *luteinizing hormone* (LH) secretion with the increase of endorphin levels (10), hyperinsulinemia and hyperlipidemia (11) were found as responsible for this relationship, although there are contradictory results in the literature.
In a meta-analysis conducted by *MacDonald et al.*, no relationship between semen parameters and BMI was detected (12). Moreover, in other similar original studies, this relationship was not found (13, 14). On the contrary, in a meta-analysis conducted by *Sermondade et al.*, a negative relationship between BMI and semen parameters was detected (7). There are also original studies reporting similar results (15-17). While a statistically significant negative relationship was detected between BMI and semen volume, concentration and motility in a comprehensive cohort study including 10665 patients conducted by *Belloc*

et al., no relationship with morphology was detected (18). In another study with 42 patients conducted by *Leisegang et al.*, it was reported that BMI level and sperm concentration are negatively correlated and no correlation was detected with motility and morphology (19). In a cohort study, which *Stewart et al.* conducted with 225 fertile male patients, it was reported that BMI and sperm count are negatively correlated (20). In our study, no statistically significant relationship was found between BMI level and semen parameters. In a recent study, on the other hand, the relationship between BMI and semen parameters and reproductive hormone levels was analyzed and a statistically significant negative relationship between BMI and semen volume, SHBG and total Testosterone (T) level was detected (21). In the study conducted by *Relwani et al.*, it was reported that BMI level does not affect semen parameters but it statistically significantly decreases T, SHBG and free T level (22). In the literature, there is a general consideration that obesity especially decreases total testosterone and SHBG levels but it is partially correlated to free testosterone levels (16, 23). In our study, we observed that when BMI level is high, prolactin and total testosterone levels are significantly lower.

CONCLUSIONS

In our study, when we analyzed the relationship between BMI level and semen parameters and reproductive hormones, no relationship was detected between BMI and semen parameters. On the contrary BMI level shows a negative correlation with prolactin and testosterone levels. However, to reveal the relationship between BMI and male infertility, large, randomized and prospective studies are needed.

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