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Correlation of Body Mass Index on Semen Parameters

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ABSTRACT

Background: Studies done to determine relation of increase in Body mass index and semen parameters have shown conflicting results, some showing negative correlation others showing none. This study aimed to find out if there is any association between them in our population.

Methods: A cross-sectional study was performed in an infertility clinic in 2018/19 reviewing records from which Body mass index of male partner and results of semen analysis noted. Participants were grouped according to Body mass index; normal: 18.5–24.99 kg/m2, overweight: 25–29.99 kg/m2 and obese: >30 kg/m2. Different semen parameters such as volume, total count, concentration and motility were compared between different Body mass index groups to determine if there is any association between them.

Results: Total 249 participants enrolled with mean Body mass index of 25.1 ± 3.4 years. Semen volume decreased with increase in Body mass index (p value 0.063) and sperm count was lower in overweight and obese group compared to normal Body mass index group (p value 0.449) suggesting insignificant negative correlation of Body mass index with semen volume and sperm count. However there was insignificant weak positive correlation of Body mass index with sperm concentration and progressive motility (p value 0.668 and 0.973 respectively). Overweight persons were 3.14 times likely to have hypovolemia (OR:3.14; 95%CI: 1.51-6.53) and obese persons were 1.19 times likely to have oligospermia (OR:1.19 95% CI: 0.42-3.36) compared to persons with normal Body mass index.

Conclusions: Body mass index has insignificant negative correlation with semen volume and total sperm count and persons with higher Body mass index were more likely to have hypovolemia and oligospermia compared to person with normal Body mass index.

Keywords: Asthenospermia; body mass index; hypovolemeia; oligospermia; semen parameters.

INTRODUCTION

It is well known that overweight and obesity can cause ovulatory and menstrual disorders, consequently affecting female fertility but their effects on male reproductive function has not been clearly demonstrated.[1] Increase in body mass index (BMI) is associated with decreased semen quality, affecting volume, concentration, motility and morphology.[2] Such impact of obesity on semen parameters has been proposed to be multifactorial such as increase in estrogen level due to peripheral aromatization, decreased testosterone level, decreased gonadotropin secretion, decreased binding capacity of sex hormone-binding globulin.[3-7] However various studies have shown mixed results. Some observed negative associations with semen parameters[5] such as count,[8-10] concentration,[9-13] motility[10,11,14] and number of normal morphological forms,[13] others found no association.[15-17] Till date information on such association in our population has not been explored so this study aimed to find out any association between high BMI, a modifiable risk factor, and semen quality so that if any association determined emphasis on weight reduction can be made in men with infertility.

METHODS

This was a hospital based cross-sectional study conducted in infertility clinic of department of obstetrics and gynaecology, Tribhuvan University Teaching Hospital (TUTH), Kathmandu from 15th March 2018 to 14th March 2020. Ethical approval from the Institutional Review Committee of IOM and Research Department was taken before starting study. The sample size was determined using a single proportional formula $Z^2 \times p\ (1-p)/d^2$ using a prevalence rate of infertility in a Teaching Hospital

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in Eastern Nepal of 5.45%.[18] Taking standard normal deviation (Z_α) at confidence limit of 95%, and 7% margin of error (d), and after adjusting for a non-response rate 10%, the total sample size was 215.

Male partner of infertile couple meeting definition of infertility attending infertility clinic during the study period were included. Couple's records obtained from infertility clinic were reviewed. Detail clinical history such as age, type and duration of subfertility, smoking and alcohol intake, previous pelvic or scrotal surgery extracted from records were noted in the Performa. If there was lack of information on BMI of male partner, lack of complete investigation report, history of genital tract infection, varicocele or genital tract surgery then the person was excluded from the study. Anthropometric measurements of weight in kg, height in meter and BMI calculated as kg/m^2 was noted. Participants BMI were grouped according to WHO as follows normal:18.5–24.99 kg/m2, overweight: 25–29.99 kg/m2 and obese: >30 kg/m2.[19] Results of semen analysis of male partner done after 3 to 5 days abstinence was also noted. Different semen parameters were compared between different BMI groups and any correlation of each parameter with BMI was determined. Semen parameters were again classified as abnormal according to WHO 2010 as follows: volume <1.5 ml (hypovolemia), concentration <15 million/ml (oligospermia), progressive motility < 32% (asthenospermia) and frequency of abnormal semen parameters in each group were also determined.[20] The data was entered into the Excel spreadsheet and transferred into SPSS v20 for analysis. The results were presented in terms of frequency, percentage and table. The associations were conducted through chi-square test, correlation, and logistic regression. A p value <0.05 was considered significant.

RESULTS

Total 249 participants were included in the study, the personal profile of which is shown in Table 1. Mean age was 31.7 + 5.1 years, the mean duration of infertility was 3.1 + 2.9 years and majority of study participants were non-smoker (72.9%) and didn't consume alcohol (62.9%). There was no statistical significant difference in these profiles in different BMI groups. Primary infertility (70.3%) was seen more than secondary infertility (29.7%).

Table1. Relationship between BMI and personal profile of the study participants (n=249).

Parameters	Total	BMI classification			P-value[a]
		Normal	Overweight	Obesity	
Number (%)	249 (100)	129 (51.81)	96 (38.55)	24 (9.64)	
BMI (mean ± SD)	25.1 ± 3.4	22.4 ± 1.7	27.1 ± 1.3	31.4 ± 1.6	<0.001*
Age (mean ± SD)	31.7 ± 5.1	31.2 ± 4.9	32.2 ± 6.1	31.8 ± 4.9	0.324
Duration of infertility (mean ± SD)	3.1 ± 2.9	2.9 ± 2.8	3.3 ± 3.1	3.3 ± 3.4	0.612
Type of infertility [n (%)]					
Primary	175 (70.3)	99 (77.5)	57 (58.6)	19 (76)	0.006*
Secondary	74 (29.7)	28 (22.5)	40 (41.4)	6 (24)	
Smoking					
Yes	69 (27.1)	35 (27.3)	24 (25)	10 (41.7)	0.258
No	180 (72.9)	94 (72.7)	72 (75)	14 (58.3)	
Alcohol intake					
Yes	92 (36.9)	45 (34.8)	34 (35.4)	13 (54.7)	0.190
No	157 (63.1)	84 (65.1)	62 (64.6)	11 (45.3)	
Semen volume, ml [(mean ± SD)]	3.1 ± 1.4	3.2 ± 1.3	2.8 ± 1.4	2.9 ± 1.1	0.063
Total count [(mean ± SD)]	94.9 ± 74.4	100.5 ± 80.6	87.6 ± 66.7	91.8 ± 74.9	0.449
Sperm concentration, mil/ml [(mean ± SD)]	32.3 ± 21.9	31.9 ± 20.9	33.6 ± 23.7	29.1 ± 19.7	0.668
Progressive motility [(mean ± SD)]	39.9 ± 21.3	39.6 ± 21.3	40.3 ± 22.4	40 ± 17.1	0.973

*[a] denotes one-way ANOVA test was used for continuous data and chi-square test was used for categorical data; *denotes statistically significant at p<0.05*

The distribution of BMI among the study participants is shown in Figure 1. Among total participants 129 (51.81%) were having normal BMI, 96 (38.55%) were overweight and 24 (9.64%) were obese. The mean BMI of total participants was 25.1 + 3.4 kg/m^2.

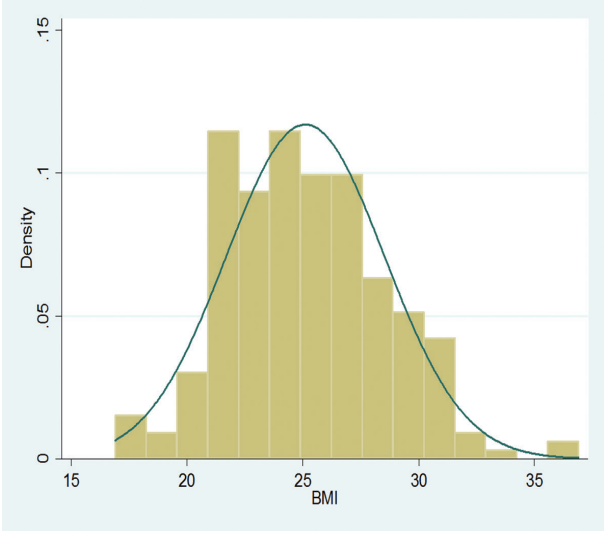

Figure 1. Distribution of BMI (n=249).

The values of semen parameters according to their BMI were studied which showed decrease in semen volume with increase in BMI (p value 0.063) as shown in Table 1. Sperm count was also lower in overweight and obese group compared to normal BMI group (p value 0.449). So, there was negative correlation between BMI and semen volume and sperm count but it was not statistically significant (Table 2). However compared to normal BMI group sperm concentration was lower in obese but high in overweight group (p value 0.668) and progressive motility was low in overweight and high in obese (p value 0.973). Hence positive correlation between BMI and sperm concentration and progressive motility was determined this was also not statistically significant (Table 2).

Table 2. Correlation between BMI and different semen parameters.

Parameters	BMI	
	Pearson correlation (r)	P-value
Volume (ml)	-0.115	0.079
Count	-0.078	0.232
Concentration	0.008	0.904
Progressive motility	0.012	0.865

Table 3 demonstrates frequency of normal and abnormal sperm parameters (hypovolemia, oligospermia, azoospermia, asthenospermia) among different BMI groups. The most common abnormality seen was asthenospermia seen in 58% (135) of participants.

Table 3. Frequency of normal and abnormal sperm parameters in different BMI groups (n=249).

Variables	BMI categories n (%)			Total n (%)
	Normal	Overweight	Obesity	
Semen volume				249
Hypovolemia	13 (10)	25 (26)	2 (9)	40 (16)
Normal	117 (90)	71 (74)	21 (91)	209 (84)
Sperm				(249)
concentration	33 (26)	16 (16.5)	6 (25)	55 (22)
Oligospermia	92 (72)	73 (75.25)	14 (58.33)	179 (72)
Normal Azoospermia	3 (2.34)	8 (8.24)	4 (16.66)	15 (6)
Sperm motility				(224)
Asthenospermia	70 (56)	52 (58)	13 (65)	135 (58)
Normal	55 (44)	37 (42)	7 (35)	99 (42)

Association between BMI and abnormal semen parameters was analyzed by bivariate logistic regression analysis taking normal BMI as reference which demonstrated that overweight persons were 3.14 times likely to have hypovolemia (OR:3.14; 95%CI: 1.51-6.53) and obese persons were 1.19 times likely to have oligospermia (OR:1.19 95% CI: 0.42-3.36) compared to person with normal BMI (Table 4).

Table 4. Association between BMI and abnormal semen parameters.

Variables	Sperm volume <1.5 ml		Sperm concentration <15 M/ml		Sperm motility <32%	
	OR (95% CI)	P-value[1]	OR (95% CI)	P-value[1]	OR (95% CI)	P-value[1]
BMI						
Normal	Ref		Ref		Ref	
Overweight	3.14 (1.51-6.53)	0.002*	0.61 (0.31-1.19)	0.150	0.90 (0.52-1.56)	0.724
Obesity	0.85 (0.17-4.04)	0.838	1.19 (0.42-3.36)	0.736	0.68 (0.25-1.83)	0.552

*[1]denotes bivariate logistic regression; *denotes statistically significant at p<0.05; OR: odds ratio*

DISCUSSION

Obesity has been proposed to be associated with male factor infertility because of its deleterious effect on semen quality for which several factors are speculated to be responsible among which the generally accepted mechanism is aromatization of testosterone to estradiol by peripheral adipose tissue resulting in decreased testosterone and high levels of estradiol. Consequently suppression of the hypothalamus-pituitary gonadal axis via negative feedback inhibition can reduce sperm parameters and result in subfertility.[6] To determine impact of male body mass index on semen parameter in couple with infertility this study was done. In the present study mean age was 31.7 + 5.1 years consistent with other studies.[8,11,12,17] The mean BMI was 25.1 + 3.4 kg/m^2 however other studies reported similar,[2,17] slightly low [12] and high mean BMI.[8,11,14] The variation in the mean BMI could be due to variation in geographical region, age groups and different number of study population in different studies.

Studies have shown significant negative correlation of BMI with semen volume but in the present study though there was negative correlation it was not significant.[2,7,8] Total sperm count was lower in overweight and obese group compared to normal BMI group showing insignificant negative correlation which is supported by Jenson et al who also demonstrated lower total sperm count in men with BMI>25kg/m^2 compared to normal BMI.[9] A significant negative linear association of sperm concentration with BMI was noted in several studies[2,3,7,8,12] but in contrary no any significant correlation was determined in the current as well as in other studies.[8,17]

Significant and negative relationship between BMI and sperm motility has been determined in several studies[2,3,4,7,11] however our result contradicts with these findings as there was insignificant positive correlation. Other studies also didn't determine the relation between BMI and sperm motility.[9,12,22] Overweight persons were 3.14 times likely to have hypovolemia compared to person with normal BMI (OR:3.14; 95%CI: 1.51-6.53) finding similar to another study.[2] Along with that obese persons were 1.19 times likely to have oligospermia (OR:1.19 95% CI: 0.42-3.36) which was also in accordance to other studies. [2,4,11,12]

Findings of studies done to determine relationship between obesity and semen quality are conflicting. Belloc at el concluded that increased BMI was associated with decreased semen quality, affecting volume, concentration, and motility which were agreed by other studies.[2,4,7,21] Studies have also determined hormonal changes such as increased estrogen, increased gonadotrophins and decreased testosterone levels along with the detrimental effect of increased BMI on semen parameters.[3,7,9] however hormonal profiles were not studied in our study. On the other hand a systematic review done by MacDonald et al including 31 studies with 5 included in the pooled meta-analysis with a total of 6,793 men, concluded that there was no strong relationship between BMI category and different semen parameters[16] finding consistent with another study.[15] Discrepancy in findings could be because of different sample size as well as variation in study population some involving men with infertility others involving general population. Present study determined insignificant negative correlation with semen volume and total sperm count but there were certain limitations. Though information on confounding factors such as smoking and alcohol intake were taken and distribution of which did not vary significantly among different BMI groups other factors such as environmental factors, abstinence duration were not addressed due to lack of information available on records. Also this study was conducted in single institution with low sample size involving only men seeking infertility treatment that prevented generalization of the result to larger population. Studies have demonstrated association of general obesity (measured by BMI) as well as central obesity (measured by waist circumference, hip circumference, waste to hip ratio), which was not evaluated in this study, with poor semen quality[7,12,23] hence further study exploring these aspects may help in better understanding in future.

CONCLUSIONS

Body mass index has insignificant negative correlation with semen volume and total sperm count and weak positive correlation with sperm concentration and motility. Persons with higher BMI were more likely to have hypovolemia and oligospermia compared to person with normal BMI. For better understanding further longitudinal study involving larger population with or without infertility is needed.

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